U.S. EPA BASE STUDY
STANDARD OPERATING PROCEDURES
FOR DATA PROCESSING
AND DATA MANAGEMENT

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LIST OF ABBREVIATIONS AND ACRONYMS

ASP	Administrative Support Person
BASE	Building Assessment Survey and Evaluation
cc/min	cubic centimer per minute
cfm	cubic feet per minute
CFU	colony forming units
CO	carbon monoxide
COC	Chain of Custody
CO_2	carbon dioxide
EH&E	Environmental Health & Engineering, Inc.
DF	dilution factor
DSP	Data Support Person
DV	dilution volume
FTL	Field Team Leader
FTM	Field Team Member
HSPH	Harvard School of Public Health
HVAC	heating, ventilating, and air-conditioning
IADCS	Indoor Air Data Collection System
IHTR	Industrial Hygienist Technical Reviewer
LOD	limit of detection
LOQ	limit of quantitation
MIS	Manager of Information Systems
MTR	Monitor module of IADCS
NTP	normal temperature and pressure (25° C, 760 mm Hg)
PD	performance determination
PE	performance evaluation
ppb	parts per billion
ppm	parts per million
$PM_{2.5}$	particulate matter 2.5 μm or less in diameter
PM_{10}	particulate matter 10 μm or less in diameter
QA/QC	quality assurance/quality control
QSN	Questionnaires module of IADCS
RA	return air
RH	relative humidity
SA	supply air
SAS	Statistical Analysis Software
STP	Standard Temperature and Pressure
SVY	Survey module of IADCS
VOC	volatile organic compound
μg	microgram
μm	microns

1.0 INTRODUCTION

The purpose of the Standard Operating Procedures (SOP) for data management and data processing is to facilitate consistent documentation and completion of data processing duties and management responsibilities in order to maintain a high standard of data quality. This SOP also serves to ensure all procedures are standardized across buildings.

1.1 DATA PROCESSING ROLES

The lists on the following pages outline the major tasks to be performed by the individuals serving these roles.

Project Manager (PM)	The PM is responsible for the final data product and has oversight on all decisions affecting the data processing procedures. Maintains the submittal schedule.
Field Team Leader (FTL)	The FTL is responsible for the completeness and organization of all field data, and the generation of building summaries. The FTL ensures the completeness of IADCS SVY, coordinates data processing , and reviews all data prior to submittal.
Field Team Members (FTMs)	FTMs are responsible for IADCS MTR data entry and building plans. They also assist with data review.
Administrative Support Person (ASP)	The ASP is responsible for questionnaire data entry, film processing and photo captions, and submittal notebooks.
Data Support Person (DSP)	The DSP receives integrated data, reviews and edits continuous data, completes and verifies data for IADCS MTR and QSN.
Manager of Information Systems (MIS)	The MIS manages automated processes for data formatting, validation, and SAS integration. The MIS prepares and submits electronic data in its final format to the U.S. Environmental Protection Agency (EPA).

Industrial Hygienist Technical Reviewer (IHTR)	The IHTR reviews continuous and integrated data during data processing. This person may be an FTL or FTM.
Quality Assurance/Quality Control (QA/QC) Officer	The QA/QC Officer (with Industrial Hygiene training) ensures that proper data validation procedures are followed and reviews integrated data prior to submittal.

PM

	Building	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Master Blaster	FTL															
Continuous Data	FTL/DSP															
IADCS.SVY	FTL															
IADCS.MTR	FTM/DSP															
IADCS.QSN	ASP/DSP															
Weather Data	DSP															
Integrated Data--preliminary	DSP															
Integrated Data--processing	MIS															
Building Summaries	FTL															
Photos																
Building Plans	FTM/ASP															
Final Notebooks	FTL/ASP															
SAS Validation Review	MIS/PM															
Building Reports	FTM/PM															

FTL

Building	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Master Blaster review & organization															
Logsheets (completeness & organization)															
Logsheet review															
Back-up diskettes (IADCS)															
Continuous diskettes															
Photos															
Receive prints from ASP															
Select photos to submit to EPA															
Write captions															
Proof captions															
Final check (slides, prints, digital)															
IADCS SVY															
IADCS Survey review															
Notify MIS of data readiness															
IADCS MTR															
Review meeting with FTL or PM															
Continuous Data															
Final review															
Notify MIS of data readiness for Bld Sum chart prepn															
Submittal Notebooks															
Final review															

FTMs

Building	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Master Blaster review & organization															
Fixed logsheets (completeness & organization)															
Calibrations															
Questionnaires															
Verify completeness of summary info on the package															
Give to ASP for data entry															
Film															
Give to ASP for processing															
Building Plans and Survey Maps															
minimum: diffusers, radon, HVAC (multiple), study area															
Select plans--esp. HVAC															
Clean plans: white label over name & address, retain plan #, highlighting															
Give plans to ASP for duplication															
Highlight copies for EPA, remark notes															
Determine labels and give to ASP for typing															
File unused plans in a tube in the plan room (see Mike Dykens)															
IADCS SVY															
Complete data entry															
Notify FTL of readiness for review															

FTMs (Continued)

Building	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IADCS MTR															
Complete data entry															
Notify DSP of readiness for QA															
Enter adjusted volumes															
Notify MIS of readiness for SAS															
Integrated Data															
Antigen data (Vespa) entered by hand															
Volume calculations & corrections															
Blank Corrections for Aldehydes and PMs															
Enter info from field notebook into comments column															
Notify MIS															
Pre-SAS data review for data completeness															
Post-SAS data review: ID corrective actions for MIS															
Building Summary															
Prepare															
QC															
Notebooks															
Final review with PM															
Building Reports															

ASP

Building	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Film															
Send film to Seattle Filmworks															
Receive: 2 sets prints, 2 sets slides, 1 digital copy															
Give 1 set prints to FTL for captions															
Type captions															
Receive proofed captions back from FTL															
Print and adhere labels to slides and prints															
Adhere colored dots to slides															
Copy disks to n:\1studies\YRseason\data\photos\raw\bldg															
Make electronic albumns with captions of selected photos															
Request final check by FTL (slides, prints and digital)															
Notify MIS of photo file location															
File photos and slides to submit in EPA and EHE binders															
Discard unwanted prints and slides, file negatives															
Building Plans and Survey Maps															
minimum: diffusers, radon, HVAC (multiple), study area															
Duplicate plans (from FTM)															
Print and adhere labels per FTM															
Fold and file 2 sets in EHE & EPA binders															

DSP

Building	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Weather															
Obtain digital WX for the week (Tues - Thurs)															
Import WX into Excel															
Format: date time temp dewpt RH pressure															
Make conversions: time (local 24h), temp (C), pressure															
Include only Tues 7am - Thurs 7pm															
Notify MS of readiness															
Integrated Data (receipt and filing)															
Prepare binder for Integrated data (cover, tabs)															
Receive and file pink copies of COC forms from FTM															
Receive data (diskette & print copies) and COC from labs															
File paper copies in the binder															
Download data to "raw" files, file disks in binder															
Aldehydes (Berkeley)															
Biologicals (HSPH)--bacteria (air)															
Biologicals (HSPH)--bacteria (dry)															
Biologicals (HSPH)--bacteria (liquid)															
Biologicals (HSPH)--fungi (air)															
Biologicals (HSPH)--fungi (dry)															
Biologicals (HSPH)--fungi (liquid)															

DSP (Continued)

Burkards (EML)															
Particulates (Chester)															
Radon (EPA)															
VOCs (Performance Analytical)															
VOCs (Berkeley Analytical)															
Notify MIS and FTL															
Continuous Data Review															
Flag operator presence															
Remove zeros & spans and points of variance (w/ FTL)															
Record problems															
Notify IHTR of readiness for final chart/data review															
IADCS.MTR															
Data entry by FTM if not done in field															
QA															
Review meeting with FTL or PM															
Questionnaire															
QA 10%															
Notify MIS of readiness															
Recruiting Statistics															
QA 5%															

MIS

Building	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Continuous Data															
Set up directories and subdirectories, "raw", "working",															
Format data															
Generate graphs															
Notify DSP of readiness for data review															
Develop graphs for Building Reports															
Integrated Data -- processing															
Formatting															
Coding															
Prepare for QC															
move QC samples to QC file															
remove QC samples from original file															
Make QC file															
convert to .dbf format															
Generate printouts for QA/QC Officer															

MIS (Continued)

Import to SAS															
IADCS (SVY, MTR, QSN)															
Weather															
Continuous															
Integrated															
Building Summaries															
SAS Validations															
Charts for Continuous monitoring															
Run validation programs															
Print out all data for review by FTL															
Implement corrective actions															
Electronic Submittal															

QA&QC

Building	1	2	3												
Integrated Data	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
QA volumes															
Review final data printouts															
Aldehydes															
VOC--Summa															
VOC--Multisorbent															
Particulates															
Dust															
Radon															
Bulk															
Biologicals															
Bacteria-air															
Bacteria-dry															
Bacteria-liquid															
Fungi-air															
Fungi-dry															
Fungi-liquid															
Review the QC file															

IHTR

Building	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Integrated Data															
Check laboratory coding															
Post-coding calculations															
Flag integrated data															
Blank Corrections for Aldehydes and PMs															

2.0 CONTINUOUS DATA PROCESSING

2.1 INTRODUCTION

This section is divided into the following subjects. Section 2.2 gives background information about continuous monitoring data. Section 2.3 gives a general overview of the data processing steps. Sections 2.4 through 2.7 give more specific instructions for carrying out each step.

2.2 BACKGROUND

Continuous data is recorded Monday through Thursday at the four fixed sites, an outdoor site, and in the supply air and the return air ducts of the heating, ventilating, and air-conditioning (HVAC) system. Each day, a field team member downloads the data onto a floppy disk.

Field team members keep a log for each site, recording the start, stop and download times of the dataloggers. The field team also notes each time one of them was present at the site.

Once the data returns to the Environmental Health & Engineering (EH&E) office, it goes through a three-stage process of formatting, reviewing, and validating to ensure a quality data set.

The following list indicates the equipment used and type of data recorded at particular sites:

S0 - Metrosonics (carbon monoxide [CO], carbon dioxide [CO_2]), Novalynx (dry bulb temp, dew point temp). Note: In some studies, heating, ventilation, and air-conditioning (HVAC) continuous measurements may be monitored in the HVAC system supply air (SA) and return air (RA). In these cases, the parameter of CO_2 will be monitored by a TSI unit.
S1 - Metrosonics (CO_2, CO, temp, RH, light, sound)
S2 - Metrosonics (CO_2, CO, temp, RH)
S3 - Metrosonics (same parameters as S1)
S5 - Metrosonics (same parameters as S1)
RA - TSI (CO_2)
SA - TSI (CO_2)

Note: Although the Metrosonics datalogger is usually used to record sound, the Quest datalogger is used occasionally as a back-up.

2.2.1 FILE NAMING CONVENTIONS

While in the field, data from all dataloggers is downloaded on to a laptop computer on Tuesday (T), Wednesday (W), and Thursday (R) evenings and transferred to floppy disk. The data is usually downloaded once per day. However, as problems occur, the data may be downloaded more than once.

Field Team Members organize data on the disk by site and type of logger (S0 = outdoor site, S1 = Fixed Site 1, S2 = Fixed Site 2, S3 = Fixed Site 3, S5 = Fixed Site 5, S0 = Outdoor Site, RA = return air, SA = Supply Air). The field team puts the disks in each building's "Book."

After the field week, the DSP gets the disks from the "Book" and transfers data files to the appropriate directory on the n:\ drive of the EH&E fileserver (the field copies act as backups).

The Field Team names the downloaded files (e.g., CA7S3R22) according to Table 2.1.

Table 2.1 Continuous Data File Name Coding

Identifier Element	Definition of Element
CA7	Building identifier: incorporate the building identifier from the BASE building code, limiting it to three characters. Each building should have the two digit postal abbreviation for the state, plus a one digit number unique to that building. This digit is the second digit in the building code. For example, 17 is 7; 03 is 3. (CA= California, 7= the second digit of the building number).
S3	Site identifier: indicates the site where the data was collected. The site location codes are: S0 (outdoor site), S1, S2, S3, and S5 (indoor fixed sites), SA (for continuous supply air), and RA (for continuous return air). If there are 2 air handlers, use SA1, SA2, RA1, RA2, and drop the digit representing the incidence of downloading (see below).
R2	The day and number of the downloading: days are abbreviated as M (Monday), T (Tuesday), W (Wednesday), R (Thursday), and F (Friday). The number (beginning with 1) represents the incidence of downloading over the course of a single day in case more than one downloading per day becomes necessary.
2	Datalogger identifier: specific datalogger models are used to record data at each site. 1 stands for Metrosonics AQ-501, 2 for Metrosonics AQ-502, M stands for Metrosonics dl-714 and the Young Processor, N for Novalynx, and T for TSI (HVAC monitoring).

All dataloggers have the capacity to download their files in either .txt, .prn, or .rpt formats. Exceptions include the TSI which must first be exported to Excel for a .txt extension and the Novalynx files which, upon initial download, attach no extension. The .prn extension is added when the file is opened in Excel.

NOTE FOR ALL DATA HANDLERS: When processing the data, use the Thursday files whenever possible, as they should contain complete data for all four days. If data was downloaded more than once in a day, use the file which was downloaded latest.

Consult field personnel to clarify any unusual file names.

2.3 DATA PROCESSING OVERVIEW

2.3.1 Stage 1 Processing: Macros (MIS)

The MIS runs various macros to format the raw data. The macros save raw data as *Excel* Workbooks in “working” directories and generate charts to allow graphical review of the data for outliers, trends, and overall presentation. For more information on this step, see Section 2.3.

2.3.2 Stage II Processing: Data Review (DSP & FTL)

2.3.2.1 Preliminary Data Review (DSP)

The DSP reviews the data and the charts to gain an overall sense of the data and verify the initial data points, making sure the dates and times are consistent with the starting date and time in the log book. If the dates and times are not consistent, the DSP works with the Field Team Leader to correct the problem.

2.3.2.2 Flagging Operator Presence Times (DSP)

While the monitors are running, the field team members keep a log of all their activities at each site, as datalogger sensors are very sensitive to the presence of people. Every time a field team member goes to a site, they must record arrival time, departure time, and a description of their activity at the site. The use of walkie-talkies also affects sensors.

Using the log book, the DSP denotes periods of operator presence and walkie-talkie use in the continuous data files by inserting a pound sign (#) over this time period in the column labeled **Op Pres** for each of the site data files.

2.3.2.3 Data Cleaning (DSP & FTL)

The FTL and the DSP review data collection parameters and numerical ranges by examining the charts generated by the macros. They check the charts for reasonableness, sensor drift, start/end times, and sensor performance.

The DSP reviews the charts for extreme measurement points and removes data points that do not appear to be representative of the data collected at the site (i.e., zero/span sensor verification, clear investigator influence or interference, equipment malfunction).

2.3.2.4 Final Data Review (FTL/PM)

The Field Team Leader or Project Manager reviews all the charts and makes any final deletions.

For complete instructions for flagging operator presence times, data cleaning, and review, see Section 2.5.

2.3.3 Stage III: Final Processing (MIS)

Some data cleaning must be completed before importing into SAS using SAS Access. Column headings must be changed to match the field names in SAS, etc. Data files for different sites are usually combined to minimize the number of required imports (importing is slow).

For more information about final processing, see section 2.6.

2.3.4 Stage IV: Data Validation (MIS)

Once the data is in SAS, the MIS will run various validation programs, generating printouts which highlight any inconsistencies in the data.

For more information about data validation, see section 2.7.

2.4 STAGE 1: FORMATTING DATA WITH MACROS (MIS)

The following sections describe the different macros for processing data from various dataloggers.

2.4.1 Processing Metrosonics Continuous Data

There are several macros which are basically the same, but vary slightly depending on the specific logger (501, 502, 714).

2.4.1.1 Formatting

Each Metrosonics macro performs the following steps:

- Deletes all rows above the data rows making sure not to delete the row containing the date stamp. In the raw file, the date stamp is located in the time column in the row above the first data row.

- Inserts a new column to the left of the time column. This will now become the date column.

- Removes the *Date* stamp above the first line column and places it in the new date column at the left of the first time stamp.

- Removes all double quotes from the data set.

- Copies the date all the way down through the last data row, making the appropriate changes when the time changes to the next day. Formats this column as (*mm/dd/yy_hh:mm*).

NOTE: There are generally three days of testing. In the raw file, each day's data is separated by two blank rows caused when the machines are put in standby mode at approximately 17:00 on each downloading day. The macro removes these blank rows from the data set.

The data contained in each column will vary by outdoor versus indoor site location. Data column designations for both the indoor and outdoor sites are indicated below.

Outdoor Site Column Headings

Column	A	B	C	D	E
Parameter	Date	Time	CO	CO_2	Op Pres

Indoor Sites 1, 3, and 5 Column Headings

Column	A	B	C	D	E	F	G	H	I	J	K	L
Parameter	Date	Time	CO_2	RH	Light	Sound	CO	T1	T2	T3	T4	Op Pres

Indoor Site 2 Column Headings

Column	A	B	C	D	E	F	G
Parameter	Date	Time	CO_2	Temp	RH	CO	Op Pres

Indoor Site 2 Column Headings (in a separate file)

Column	A	B	C	D	E	F	G
Parameter	Date	Time	Temp1	Temp2	Temp3	Temp4	Op Pres

Note: Neither illuminance nor sound measurements are recorded at Site 2.

2.4.1.2 Metrosonics Charts

The macros create various charts from the data as a means of evaluating data quality, trends, or potential problems in the data. Macro tasks are listed as follows.

***Sites 1, 3, and 5*:** Saves these charts as separate sheets within the working *Excel* spreadsheet file.

- **Chart 1:** Using a combination chart, plots CO concentration and CO_2 versus time. The CO and CO_2 axes are on opposite sides of the chart.

- **Chart 2:** Using a line chart, plots RH versus time.

- **Chart 3:** Using a line chart, plots Lux versus time. (This chart is not generated for duplicate sites).

- **Chart 4:** Using a line chart, plots all four temperature measurements versus time.

- **Chart 5**: Using a line chart, plots sound level versus time. (This chart is not generated for duplicate sites.)

Site 2:

- **Chart 1:** Using a combination chart, plots CO concentrations and CO_2 concentrations versus time.

- **Chart 2:** Using a combination chart, plots temperature and relative humidity versus time.

- **Chart 1:** (in a separate workbook) Using a line chart, plots all four temperature measurements versus time.

Outdoors: Creates two charts for the outdoor site.

- **Chart 1:** Using a combination chart, plots CO concentrations and CO_2 concentrations versus time.

- **Chart 2:** Using a combination chart, plots temperature and relative humidity versus time.

2.4.2 Processing Novalynx Continuous Data

The Novalynx macro performs the following steps:

- Deletes all rows above the data rows.

- Inserts various columns and adds the appropriate titles to the columns.

- Adds the date column and time column to make a new date-time column.

- Changes the data from: Date-time, Value1, Value2, Value3, Value4 to: Date-time, Value. Value1, Value2, Value3, and Value4 are the same type of data measured

over a five-minute interval. The macro calculates the proper date-time for each value, and transposes the data.

- In the raw data, the temperature, dew point, and barometric pressure are in separate sets, one below the other. The macro shifts the data into side by side columns.

- Calculates the RH from the dew point data.

- Deletes the raw data which was used for the above calculations.

- Checks to make sure the date-time values for the temperature data match up with the date-time values for the RH and pressure data. If the date-time values do not match up, the macro stops to allow inspection of the data. In this circumstance, make appropriate changes and complete the final steps by hand.

- Using a combination chart, plots temperature and relative humidity values versus time. The temperature and RH axes are on opposite sides of the chart.

Column Headings

Column	A	B	C	D	E
Parameter	Date and Time	temp, C	RH%	Pressure	Op Pres (added manually)

2.4.3 Processing Quest Continuous Data

Unlike other data which uses EH&E macros, the Quest continuous monitoring data uses a macro from the sensor manufacturer. To run the Quest macro, perform the steps listed below.

TIP: Make a note detailing the path and file name of the file to be formatted. The macro prompts the user to enter this information.

- In the template directory in Excel, open quest\questm28\questm28.wk1 (a macro which imports the data file).

- Type the path and filename of the raw data file at the prompt at the top of the screen.

The macro outputs the average dB values and the maximum dB value for every minute. The final data set will not include the maximum values.

When the macro is complete:

- Search for the word “histogram” in first column. This will take you to the beginning of three columns of data with the headings Time, Max, and Levels. Copy and paste Time and Levels columns into columns B and C of a new workbook. (Do not include max data.)

- Close macro file without saving changes.

- In the new file, use the Chart Wizard to make a chart to plot time vs. levels. For chart type, select line graph, then style #2.

- Fill in dates in column A. To determine the start date, reference the field log. Double-check the chart to make sure the dates and times make sense (i.e., the dB levels are low at night and higher during the day). The sound levels are highest on Wednesday, since the equipment running that day provides steady background noise.

- Add a column on the right for Op Pres, as shown below.

Column Headings

Column	A	B	C	D
Parameter	Date (data added manually)	Time	Levels	Op Pres (data added manually)

- Save the file in the appropriate continuous data working directory.

2.4.4 Processing TSI Continuous Data

The TSI macro performs the following steps.

- Deletes all rows above the data rows.
- Adds column titles.
- Formats date and time columns.
- Deletes blank rows.
- Generate a combination chart which plots CO_2 versus time.

Column Headings

Column	A	B	C	D
Parameter	Date	Time	CO2	Op Pres (added manually)

2.5 DATA FLAGGING AND REVIEW (DSP/FTM)

Once the raw data is in an Excel format, it is ready for flagging and review. Reference the field log for start and stop times and operator presence.

2.5.1 Flagging

- Review the time column, especially during downloads. If there are gaps greater than ten minutes, insert a row(s) containing date and time.

- Data at all sites should begin at approximately the same time, as recorded in the site logs. Delete any data prior to the start time recorded in the log. If the data begins significantly later than the recorded start time, insert blank rows with times and dates to represent the time missing.

- Add a column at the right labeled **Op Pres** (the macros do not perform this step.) Flag all operator presence times with a pound sign (#).

NOTE: Except for Quest data, the data in each row is an average for the five minutes preceding the time. Quest data is recorded in one minute intervals.

2.5.2 Review

After flagging, review operator presence periods and delete data points which are obviously inconsistent with the rest of the data. Sections 2.5.2.1 - 2.5.2.4 give specific instructions for particular types of data.

It is helpful to look at the charts as data cleaning proceeds. There is a macro, which plots operator presence times on the charts. To run the macro, select **Op Pres** from the tools menu. It will prompt you for a y-value to designate the height to plot the points.

For certain parameters, sudden increases or decreases greater than 10% are suspect. Watch especially for data spikes at the very beginning and end of the data set. Work with the Field Team Leader if in doubt.

Tip: If an *Excel* chart does not respond immediately to changes made to the data set the calculation function may not have been adjusted to automatic.

For instrument malfunctions, reference the site log, find the associated times in the data file, and delete the points of variance. This should be done only with the Field Team leader. If the logbook lists a malfunction but there is no unusual data, ask the Field Team Leader about retaining or deleting data points.

2.5.2.1 Cleaning Metrosonics Data

- Delete zero and span points for CO, CO_2, and RH. Also, CO_2 , light, and humidity sensors are especially sensitive to operator presence. Metrosonics AQ-502 humidity sensors are severely impacted by zero and spanning procedures. Delete obvious outliers. Work with the Field Team Leader if in doubt. Sudden increases or decreases greater than 10% are suspect.

- If necessary, delete spikes at beginning and end of data set.

2.5.2.2 Cleaning Novalynx Data

- Remove data which do not characterize the outdoor temperature and RH accurately (due to instrument malfunction, operator interference, etc.) in consultation with the FTL.

2.5.2.3 Cleaning Quest Data

- Delete all the zeros in the data. Do not delete anything else. Work with the FTL if in doubt.

2.5.2.4 Cleaning TSI Data

- Remove data which do not characterize the CO_2 levels accurately (due to instrument malfunction, operator influence or interference, etc.) in consultation with the FTL.

- Delete points at times when field personnel removed, disconnected or adjusted sensors in return or supply air ducts. The times for SA and RA sensors are written in a common log book, but points need only be flagged and deleted for the sensor in question.

2.5.3 Final Review

- Record the start and stop times, as well as any problems, on the Continuous Data Review Worksheet. You do not need to record start and stop times for HVAC monitors.

- Save the file under a new name in the working directory by changing the "day" digit (T,W,R) to "X". For example: MN2S3R22.xls would be Saved As: MN2S3X22.xls.

- Record any problems on the Continuous Data Review Worksheet and insert the worksheet at the back of the Book.

- Let the PM know that all the data is flagged and cleaned. The PM will complete the final review.

2.6 IMPORTING DATA INTO SAS (MIS)

After the final review, the data is nearly ready for uploading into SAS. The MIS performs the following steps prior to uploading into SAS.

2.6.1 For All Types of Data

- Run a macro to copy and consolidate the data, to lessen the time to import. (There is a limit in Excel of approximately 16,000 rows). The macro adds an extra column with the file name.

- Add extra columns with functions extracting the necessary data from the file name (see filename coding instructions).

- Replace the codes with the codes required by SAS (e.g. “S” is replaced with “PRIMARY,” and “D” is replaced with “DUPLICATE”).

- Replace the abbreviated building codes with the official building codes, using a lookup table.

- Add two extra columns: one with the IADCS version number, the other with the current date and time.

- Copy the entire sheet and then “Paste Special - Values” to replace any functions with their actual values.

- Rename the columns to reflect the SAS field names (see documentation).

- Check the first row of data to make sure that text columns have text and number columns have numbers.

- Make sure the UPDATE column is wider than best fit. Best fit width for dates causes problems with SAS Access.

Once these steps are performed, the data is ready to be uploaded into SAS using SAS Access. To save upload time, import the entire file of each type of logger as one dataset. See below for specific information about various dataloggers.

2.6.*1.1* *Uploading Metrosonics Data*

Once in SAS, copies of the main data file are made, and unneeded fields deleted (e.g., name the copied datafile RH.sd2 and delete CO, CO2, Lux, T1, T2, T3, T4). Each temperature set can be appended in SAS to the temp.sd2 file, filling in the appropriate sensor height (T1=0.1, T2=0.6, T3=1.1, T4=1.7).

2.6.1.2 Uploading Novalynx Data

Once in SAS, the RH data is appended to the RH.sd2 file, and the temperature data is appended to the temp.sd2 file, filing in 1.7 as the sensor height.

2.6.1.3 Uploading TSI Data

The supply air and return air CO_2 measurements are stored in a data file (hvacco2.sd2) separate from the other CO_2 measurements. To generate the validation charts, a third data set (plotrasa.sd2) must be created with all of the RA-SA CO_2 data and the outdoor CO_2 data from the CO_2.

2.7 CONTINUOUS DATA VALIDATION IN SAS (MIS)

2.7.1 Overview

Unlike the previous steps, validation in SAS is performed by type of data, not type of instrument. For example, RH data is collected from both the Metrosonics and Novalynx dataloggers into the rh.sd2 SAS dataset. Each validation program must be run

separately for each building (the building code is changed each time before submitting the program).

2.7.2 Validation Programs

There are three types of validation programs for continuous monitoring. The first type generates a set of charts similar to the *Excel* charts for each building. These charts go through the same chart review process listed in previous sections (review by the field team leader, etc.). The program also generates statistics on each set of charts. These statistics are located in the "Output" window in SAS. The program automatically prints the charts. Print the statistics manually.

Table 2.2 Charts Generated from Type 1 Validation Program

Program Name	Function
PLOTCO.SAS	Selects data for a given building from CO.SD2 and generates daily plots of carbon monoxide readings above 3 parts per million (ppm).
PLOTCO2.SAS	Selects data for a given building from CO2.SD2 and generates interpolated daily plots of carbon dioxide readings.
PLOTLIGH.SAS	Selects data for a given building from LIGHT.SD2 and generates interpolated daily plots of light readings.
PLOTRH.SAS	Selects data for a given building from RH.SD2 and generates interpolated daily plots of relative humidity readings.
PLOTSOUN.SAS	Selects data for a given building from SOUND.SD2 and generates interpolated daily plots of sound readings.
PLOTTEMB.SAS	Selects data for a given building from TEMP.SD2 and generates interpolated daily plots of temperature tree readings taken at a single site.
PLOTTEMP.SAS	Selects data for a given building from TEMP.SD2 and generates interpolated daily plots of temperature readings taken at 1.1 meters for all sites at that building.
PLOTRASA.SAS	Selects data for a given building from PLOTRASA.SD2 and generates interpolated daily plots of CO_2 readings taken from the supply air, return air, and outdoor site.

The second type of validation has an output program if there is something unusual in the data. For example, the co2time.sas program lists those readings that were measured less than five minutes from the previous readings, and the co2_0.sas program lists those readings whose CO_2 concentration was zero.

Table 2.3 Charts Generated from Type 2 Validation Program

Program Name	Function
CO_0.SAS	Prints a table of zero values found in all of the continuous carbon monoxide data.
CO2_0.SAS	Prints a table of zero values found in all of the continuous carbon dioxide data.
CO2_TIME.SAS	Prints a table of all continuous carbon dioxide readings that are taken less than five minutes after the previous reading.
LIGHT_0.SAS	Prints a table of zero values found in all of the continuous light data.
RH_0.SAS	Prints a table of zero values found in all of the continuous relative humidity data.
SOUND_0.SAS	Prints a table of zero values found in all of the continuous sound data.
TEMP_0.SAS	Prints a table of zero values found in all of the continuous temperature data.
TABLCO2.SAS	Prints a table of statistics of continuous carbon dioxide data in CO2.SD2.
TABLRH.SAS	Prints a table of statistics of continuous relative humidity data in RH.SD2.
TABLSOUN.SAS	Prints a table of statistics of continuous sound data in SOUND.SD2.
TABLTEMP.SAS	Prints a table of statistics of continuous temperature data in TEMP.SD2.

The third type compares the continuous monitoring data with other types of data in the SAS MTR dataset. For example, a validation program reports if there was a site listed in the Fixed.sd2 dataset which did not have any CO readings (and vice versa). Obviously, before running this type of program, the other data must be uploaded from IADCS MTR.

Table 2.4 Charts Generated from Type 3 Validation Program

Program Name	Function
CO_MISS.SAS	Prints two tables. One shows carbon monoxide samplers declared in FIXED.SD2, without including readings in CO.SD2. The other table shows readings in CO.SD2 that do not have a corresponding record in FIXED.SD2.
CO2_MISS.SAS	Prints two tables. One shows carbon dioxide samplers declared in FIXED.SD2, without including readings in CO2.SD2. The other table shows readings in CO2.SD2 that do not have a corresponding record in FIXED.SD2.
LIGHT_MI.SAS	Prints two tables. One shows light samplers declared in FIXED.SD2, without including readings in LIGHT.SD2. The other table shows readings in LIGHT.SD2 that do not have a corresponding record in FIXED.SD2.
MOB_FIX.SAS	Selects data for a given building from MOBILE.SD2, CO2.SD2, RH.SD2, and TEMP.SD2 and generates a table comparing readings taken during mobile site visits with continuous readings taken during the same time at the colocated fixed site.
RH_MISS.SAS	Prints two tables. One shows carbon monoxide samplers declared in FIXED.SD2, without including readings in RH.SD2. The other table shows readings in RH.SD2 that do not have a corresponding record in FIXED.SD2.
SOUND_MI.SAS	Prints two tables. One shows sound samplers declared in FIXED.SD2, without including readings in SOUND.SD2. The other table shows readings in SOUND.SD2 that do not have a corresponding record in FIXED.SD2.
TEMP_MIS.SAS	Prints two tables. One shows temperature samplers declared in FIXED.SD2, without including readings in TEMP.SD2. The other table shows readings in TEMP.SD2 that do not have a corresponding record in FIXED.SD2.

Some helpful hints on using the validation programs.

- Optimally, the second set of validation programs should have no output; no zero values, etc., were found. Discuss any printouts of these reports with the field team leader.

- Likewise, the third set of validation programs optimally should have no output (with the exception of MOB_FIX.SAS). In other words, the same sites should be in both the IADCS fixed.sd2 dataset and the continuous monitoring data. Again, discuss any printouts with the field team leader.

- Carbon monoxide validation is unusual. Because most of the data points typically fall beneath the EPA cutoff value (3.0 parts per million [ppm]), most of the data has a code (-98) instead of a value. Consequently, the graph containing this data consists of only a few scattered data points, rather than a line graph. Likewise, the other validation programs for CO vary.

- Keep the reports in a safe place. All of the reports generated by the validation programs are sent to the EPA. SAS does not save the reports, so if they are lost or damaged, they must be completely redone.

3.0 IADCS DATA PROCESSING

3.1 QA IADCS SURVEY

Field Team Leaders and HVAC Team Members share the responsibility for IADCS SURVEY (SVY) review. ***The most effective SVY QA/QC is done while still in the field***, as this is the only time field team members have to collect missing information or to reconcile unexpected HVAC measurement results.

Once back from the field, the Field Team Leader, with assistance from the HVAC Team Member, is responsible for reviewing the SVY section for completeness and clarity. Generally, the following should be kept in mind throughout the entire SVY section:

- Confidentiality should be maintained at all times. Make sure that any building-specific information that could reveal the building's identity is removed from the database.

- Area measurements should be noted in terms of assumptions/source of information. An explanation should always be included in a note as to how particular values are obtained.

- HVAC measurements should be checked for reasonableness. Be certain the measurements "make sense for the particular system" and try to resolve discrepancies if they do not. Again, it is imperative that this occur in the field so that the field team can re-evaluate measurement strategies mid-week.

The following is a description of the three main sections of SVY and special issues relating to their respective QC processes.

3.1.1 Building Description

3.1.1.1 Physical Characterization

1. **Screen A100: Building Contacts**: Be certain that all information here is removed prior to data submittal. While it is helpful to have this information during the field week, the information cannot be submitted to EPA for confidentiality purposes.

2. **Screen A101: Building Description**: For occupied and gross floor areas, note the assumptions used in calculating these values as well as the floor plan used.

3. **Screen A102: Floor Descriptions**: Insert a note in each field of the *Number of Floors* column to identify the floor(s) counted, e.g., FL2.

4. **Screen A104: Climate and Site**: See HVAC team member to reference this information. This step can be done post-field at EH&E.

5. **Screen A105: Building Equipment**: Field Team leaders not completely familiar with the building's HVAC configurations should consult the HVAC team member for review of this section.

3.1.1.2 Ambient Sources

1. **Screen A206: Cleaning Materials**: Under the *Other* field on the screen, a note should be added that includes the specific cleaning compound names and uses, and manufacturers' names and addresses. Care should be exercised in this section, as buildings often use cleaning products from local manufacturers. These locations should be deleted as they may compromise the anonymity of the city and possibly the building.

2. **Screen A207: Pest Control - 1**: Information regarding the last dates of pesticide application should be listed in the *Exterior* and *Outdoor* fields. Additionally, the reason for each application should be noted if the information is available.

3. **Screen A208: Pest Control - 2**: The names of pesticides used on the interior and exterior of the building should be obtained from building management or their pesticide contractor and noted. Include the name of the compound, manufacturer, address, phone number, and MSDS number if available.

3.1.1.3 HVAC Systems

1. **Screens C111-C116: Maintenance**: If any of the systems listed are not present in the building, there is no need to note it - just enter the "....." option to signify that the item is not applicable.

2. **Screen C115: Maintenance - 5**: For cooling tower information, frequency of treatment choices are not listed work for automatic delivery systems. Use *As Needed* for such systems, and add a note indicating that this is the case. For scale treatment, note if both chemical and blowdown are used for descaling. Obtain the chemical name, manufacturer's name, address, and MSDS number, if available, for all cooling tower chemicals. Note all information under *compound* if it will not fit in the allotted cell.

3.1.2 Test Space Description

Refer to theTest Space Description Worksheet.

3.1.2.1 Physical Characterization

1. **Screen B101: Test Space Description**: For occupied and gross floor areas, note the assumptions used in calculating these values as well as the floor plan used.

2. **Screen B103: Space Description**: Calculate *Design floor area per workstation* by dividing the occupied floor area for the test space by the number of workstations in the study area. Include conference rooms, computer rooms, and kitchens in this calculation. Note the specific calculation.

3.1.2.2 Ambient Sources

1. **Screen B204: Cleaning**: Under the *Other* field on the screen, add a note that includes the specific cleaning compound names and uses, and manufacturers' names and addresses.

3.1.2.3 HVAC Systems

No specific items for this section.

3.1.2.4 Service Equipment

1. **"Air Handlers" Screens C121-C125: Inspection**: If any of the systems listed are not present in the building, there is no need to note this - just enter the "....." option to signify that the item is not applicable.

2. **"Air Cleaners" Screen C801: Filtration and Air Cleaning Systems**: For the filter size field, calculate the total size of the filter bank. Be sure to note the calculation.

3.1.3 Measurements

3.1.2.1 Air Handler Performance

1. **Screen D101: Supply Airflow Rate**: On the first measurement (Tues. p.m.) of supply airflow, record the dimensions of the duct area in a note.

2. **Screen D107: Outdoor Air Intake Rate:** On the first measurement (Wed a.m.) of outdoor air intake airflow, record the dimensions of the duct area in a note.

NOTE: Be consistent when entering locations of reported measurements such as: "Main Duct, 10 feet downstream from SA fan."

3.1.3.2 Exhaust Fan Performance

1. **Screen D202-D204: Exhaust Fan Airflow Rate**: If hot-wire is used, record the dimensions of duct areas in a note.

3.1.3.3 Test Space Ventilation

1. **Screen D301: Local Ventilation Performance - Devices**: If more than one balometer is used, record the second balometer in a note. Note in the next section which individual diffusers are measured with this instrument.

- If the rate of airflow is <50 cubic feet per minute (cfm), the investigator is to determine if there is some marginal air flow or no air flow. If there is no flow, enter a "0.00" value in the field. If there is some marginal, unquatifiable flow, enter 25 cfm (0.71 m3/min).

- If two measurements are made (e.g., on a light troffer diffuser) and both are < 50 cfm, determine if there is any marginal air flow in either slot. For slots without air flow record a "0.00" value, for slots with some marginal flow record 25 cfm (0.71 m3/min). The data entered into the IADCS field should represent the total air flow from the diffuser. An inserted F6 note should describe the breakdown of each slot. For example, "Flow rates from both slots of the light Troffer diffuser measured 25 cfm (1.41 m^3/min) each."

2. **Screen D302-D305: Local Ventilation - Airflow Rate & Temperature**: Be certain to note the Fixed and Mobile sites for the five diffusers in the study area.

3.1.3.4 Building Ventilation

Not currently used for BASE.

3.2 IADCS.MTR: DATA ENTRY AND QA

This section describes the procedures for entering data into IADCS Monitor and for verifying information already entered (QA).

The IADCS.MTR module is used to store all environmental measurement data collected over the course of a BASE field week. The bulk of the data is entered while in the field. After the field week, a diskette with the final field backup of IADCS is brought back to EH&E for loading onto the EH&E BASE computer. An FTM will ensure that all data has been entered and will notify the DSP who will QA the data entry.

NOTE: Field data sheets are reviewed by the FTL prior to data entry. It is important to initial the field data sheets when entering, reviewing, and conducting QA on the data.

3.2.1 General Data Entry Procedures

*3.2.1.1 Basic IADCS Commands used in MTR (***Update***) and QSN*

F5	View data for a field
F6	Enter a note
F8	Save & Exit (takes you to Quit on Main Menu)
F10	Convert data from English to metric units & vice versa
PgDwn/PgUp	Move forwards/backwards (saves changes)
Ecs	Go back a level or close a pop-up window--no changes saved
Tab	Move between fields on a page
Space Bar	Toggle on/off for an "X" in a column
Ctrl-Del	**Mark a record for deletion (this is a toggle command)**

Note: To delete records marked for deletion, go to the *Management* menu.

3.2.1.2 Data Entry

Data to be entered include: Personnel Identification, Site Identification, Fixed Site Samples, Mobile Site Samples and Other Samples (occupancy, radon, bios, bulk and QA/QC). Continuous data is not entered into IADCS.

- Enter IADCS.MTR.
- Select the appropriate building code from the pick list (see VERY IMPORTANT NOTE below).

- In the *Main Menu*, go to the *Update* menu and select the data type.

VERY IMPORTANT NOTE: DO NOT be careless and hit <Enter> on the blank field at the top of the pick list, as this will cause a complete data loss to all other buildings already on the computer. If you get into MTR and need to exit to DOS without doing anything, you must choose a building from the pick list and then **Quit** to exit.

NOTE: Once you enter a particular building within the MTR module, it is not possible to switch to other buildings without exiting the software and re-entering.

3.2.1.3 Data Restoration

Data is copied to the BASE computer hard drive from backup copies made in the field. To restore data, perform the follow the following steps. For a more detailed description of IADCS refer to the IADCS software manual.

- Enter IADCS.MTR.
- In the *Main Menu*, go to the *Management* menu and select *Restore Data FROM Diskette*. Follow the instructions on the screen; a pick list will appear of buildings contained on each particular backup disk.
- Scroll down the pick list to the building you want to work on.

3.2.2 Specific Data Entry Instructions and Conventions

3.2.2.1 Personnel Identification

Field team members are assigned a personnel identification number. These numbers are used to identify the people responsible for the various data collected.

Consult the master list of Field Personnel ID numbers for these numbers (crib sheet Admin 5).

To enter Personnel IDs

- From the *Update* menu select *Personnel Identification*.
- Type the IDs for the Field Team Personnel for that study week.

To verify Personnel IDs

- From the *Update* menu select *Personnel Identification* and press F5.
- Check this list against the Field Personnel roster on the Point Source and Pollution Event Sheet and the master Personnel Roster.

3.2.2.2 Site Set-up

Site Set-Up tells IADCS Monitor which data will be entered for the Fixed and Mobile Sites. For each of the Fixed sites (five) and the Mobile sites (five,) there is a screen to fill out to select what was sampled and which samples had duplicates. Please note that, beginning with the Summer 1997 Study, there will no longer be a duplicate continuous monitoring station. Instead the unit will be located at Mobile site 2 and shall be named Fixed site 2. So there will be a total of four separate indoor Fixed site stations. While the duplicate continuous monitoring station will not be placed at the "duplicate site", the "duplicate site" will continue to serve as a duplicate station for co-located integrated samples. The site set-up of MTR for the "duplicate station" (e.g., Fixed site 5) should reflect duplicate integrated samples and only primary continuous data. (See page 50, *IDs for BASE*).

Follow this step-by-step procedure for Site Set-up (data entry and data QA):

- To enter the site setup screen select *Update*, then *Site Identification*.
- Enter a site ID: FIX0000, FIX0001, FIX0002, FIX0003, FIX0005, MOB0001, MOB0002, MOB0003, MOB0004, MOB0005. (For QA purposes, press *F5* to view the list.)
- **Note**: the test space number is always "**01**".

Location

For all **indoor** sites, the location field references the diffuser ID assigned during Tuesday Baseline diffuser measurements. In the location field, enter: “Corresponds to # YY on the diffuser map.” Note: Mobile sites 1, 2, 3 and 5 are the same as Fixed sites 1, 2, 3 and 5. The diffuser number for these locations is the same.

For EHFIX0000 give a brief description of the actual outdoor site, e.g., “Roof: at outdoor air intake.” or “Roof: approximately 30 feet from outdoor air intake.”

- For each site, there is a screen showing all possible parameters. Use the table below as a reference to mark an ”X” in the appropriate Primary and/or Duplicate columns (space bar). Repeat this process for all ten sites (mobile and fixed).

- **Note:** Do not enter anything for Biologicals in Site Set-up.

Table 3.1

Site	Parameter	Primary	Dup
FIX 0000 (01) for test space	PM10	X	X
	PM2.5	X	X
	Ald	X	X
	VOC--Summa Cans	X	X
	CO2	X	
	RH	X	
	Temp	X	
	CO	X	
	VOC--Multisorbent Tube	X	X
Indoor (Primary & Dup - usually F5) PM 2.5 is sampled at the duplicate site only.	PM10	X	X
	PM2.5	X	X
	Ald	X	X
	VOC--Summa Cans	X	X
	CO2	X	
	RH	X	
	Temp	X	
	CO	X	
	Illuminance	X	
	Sound	X	
	VOC--Multisorbent Tube	X	X
Indoor blank and spike (indoor blank - usually F1, spike - usually F3)	PM10	X	
	PM2.5		
	Ald	X	
	VOC	X	
	CO2	X	
	RH	X	
	Temp	X	
	CO	X	
	Illuminance	X	
	Sound	X	
	VOC--Multisorbent Tube	X	

VOC volatile organic compound

NOTE: All Fixed Sites have marks in the *Primary* Column; only the outdoor site and indoor Duplicate site have marks in the *Dup* column. QC samples are not referenced in the site identifiers.

3.2.2.3 Fixed Site Sampling

Fixed site data falls into two groups. The first group consists of monitoring for particulates (PM10 and PM2.5), aldehydes, and volatile organic compound s (VOCs). The second group is environmental data from continuous monitoring: CO_2, CO, RH, temp, light, sound. There are data for each of these parameters at four indoor sites (F1, F2, F3, F5), and one outdoor site (F0). Note: there is no light or sound data collected at Fixed Site 2.

- To enter data, choose *Update* and then *Fixed Site Samples*.
- Select a site from the pop-up list.
- Sample set is always **01**.
- Use the PageDown/PageUp key to move from screen to screen.

Particulates, Aldehydes, and VOCs (Integrated Data)

Field integrated datasheets are used to record sample identification numbers, various measurements, on/off times and flows and comments, etc. There are separate field integrated datasheets for indoor and outdoor formaldehyde, PM_{10}, $PM_{2.5}$, VOC Summa Canisters, and VOC Multisorbent Tubes.

Flow calculations are made in Excel, filed under ...\data\integ\rotas\.... Place copies of these worksheets in the Master Binders for easier data entry and QA purposes.

- To enter data, type the Sample ID, then tab between fields to enter the rest of the information.

- To QA data, verify the information in each field.

- Consult the crib sheet, *IDs for BASE,* on the next page for lists of IDs and Abbreviations.

Meter Identifier = ROTA ID
Meter Reading = Flow On and Flow Off

- Insert notes (F6) if device set-up is irregular, e.g., filter placed backwards in the train.

Parameter	Expected Volume (order of magnitude)
Particulates ($PM_{2.5}$ and PM_{10})	10,000 Liters
Aldehydes	100 Liters
VOCs–Multisorbent tubes	2.4 - 3.5 Liters

- VOCs–Summa Canisters:
  Sample ID, Operator ID, Date, and Time

- VOCs–Multisorbent Tubes:
  - Outdoor site: Peristaltic pump has fixed flow rates for each of its two ports (primary & duplicate). No rotameter is used outdoors. Refer to calibrations at the beginning and end of sampling season for calculated flow rates.
  - Indoor sites: Diaphragm pump is used. Rotameter measurements are taken on each and recorded on the appropriate log sheet.

Carbon Dioxide, Relative Humidity, Temperature, Carbon Monoxide, Light, and Sound (Continuous Monitoring)

The continuous data is not entered into IADCS; however, the equipment ID numbers and the start and stop times are included.

- Data for this portion of Fixed Site monitoring is entered from the Continuous Data Review Worksheet and the Sensor Calibration Log sheets.

- Enter the start and stop times from the Continuous Data Review Worksheet.
  Note: DO NOT enter the start and stop times from the logsheets. The times on the worksheet are obtained from a review of the actual data in Excel.

- The equipment ID numbers are listed on the *Sensor Calibration Log for the Datalogger,* attached to each Log Book.

Notes about the Outdoor site: There is only one temperature monitor at the outdoor site (F0)–at 1.1 m. If the NovaLynx was used, there should be a note on the outdoor RH

in the Device ID field: “RH was calculated from the dewpoint sensor.” See the *IDs for BASE* crib sheet (following pages) for the Novalogger IDs for RH and temperature at the Outdoor Site. On several occassions, temperature and relative humidity data will be collected using a different sensor: the Young model attached to a metrosonics datalogger. It is not neccessary to generate a note since RH is measured directly. See the IDs for BASE crib sheet (next page) for the Young ID numbers for temperature and relative humidity.

IDs for BASE*

Integrated Samples

ALD - aldehydes
CAN - summa canister (VOC)
RAD - radon canister
PPM - PM10 & 2.5
BAC - bacteria (air)
FUN - fungi (air)
THR - thermophilic (air)
DUS - dust
BUL - bulk samples
TNX - multisorbent tube (VOC)

Continuous Equipment

EC2 - CO_2 monitor
ECO - CO monitor
ELI - light monitor
ENO - noise meter
ETM - temp sensor
EHU - RH sensor
EDW - dewpoint sensor (Novalogger)

Outdoor sensor IDs

NovaLynx (Novalogger)
EDWθθθ1 for RH
ETMθθ47 for Temperature
ECOθθ21 for CO
EC2θθ19 for CO_2

Young (NovaBaby)
EHUθθ31 for RH
ETMθθ52 for Temperature

Integrated Devices

EAL - aldehyde pump
EIM - PM impactor
EMC - bios impactor
EFM - flow meter
(for ALD & PPMs)
ETX - multisorbent pump
Summa Can VOC - no device

Miscellaneous

EHFIXθθθθ - Outdoor site
θθθ1 - Fixed site 1
θθθ2 - Fixed site 2
θθθ3 - Fixed site 3
θθθ5 - Fixed site 5

EHMOBθθθ1 - Mobile site 1
θθθ2 - Mobile site 2
θθθ3 - Mobile site 3
θθθ4 - Mobile site 4
θθθ5 - Mobile site 5

EHPERθθYY -
Personnel (see Roster)

HVAC Equipment
EHO - balometer
EVM - hotwire

*Under some circumstances, equipment is supplemented by EH&E. When there is no EPA IADCS code available, use an F6 note to identify the serial number of the instrument.

3.2.2.4 Mobile Site Samples

- There are four sets of data from each of the four rounds (Wednesday a.m. and p.m.; Thursday a.m. and p.m.).

- Data is recorded on the *Diffuser CFM (Mobile) Worksheet.*

- The first screen shows Start Time and Operator ID only. PageDown to move between screens.

- Supply Diffuser Measurements: There is no CO data. If there are two air handlers, make a note as to which AHU is serving the mobile sites.

Airflow

- If a unit or a diffuser was not measured either because it was inaccessible or otherwise, leave it blank and enter a note.

- If the rate of air flow is less than 50 cfm, the investigator is to determine if there is some marginal air flow or no air flow. If there is no flow enter: "0.00" in the field. If there is some marginal, unquantifiable flow, enter: "25 cfm (0.71 m^3/min)."

- If two measurements are made (e.g., on a light troffer diffuser), and both are <50 cfm, determine if there is any marginal air flow in either slot. For slots without air flow, record a "0.00" value; for slots with some marginal air flow, record 25 cfm (0.71 m^3/min). The data that is entered into the IADCS field should represent the total air flow from the diffuser (slot #1 + slot #2). Under these circumstances, it is not necessary to generate a note describing the flow in each troffer slot, only the sum.

Noise

Indicate continuous noise at each site on Wednesday a.m. and p.m. (i.e., each box should be checked). Insert note: “pumps” for each site. Use the term “radio” in place of the term “music.” Use the term “induction unit” over the term “unit ventilator.”

Housekeeping

If the area is carpeted, leave Part C, “Cleanliness of non-carpeted floors,” **blank** – and vice versa for Part D). Plastic mats under desks are considered uncarpeted areas.

3.2.2.5 Other Samples

Occupancy

The occupancy count number should be the **total** number of occupants recorded. EPA has also requested a breakdown between the number of permanently stationed (>20 hrs/wk) women and men in the study area. A note should accompany the Monday entry “YYM / YYF; includes YY Field Team members”. If the count was taken outside the prescribed time (i.e., more than 1.5 hours), then the note should read: “Taken at time YY; includes YY Field Team members.”

For the questionnaire data, the total number of questionnaires should be entered, with a note detailing how many were received on Thursday *vs*. Friday. If this information is not on the Occupant Count sheet, refer to counts on (or in) the questionnaire envelopes for the note, e.g., “50 were returned Thursday night; 5 were returned on Friday.”

Radon, Bios, Bulk and QA/QC Data

- ***To enter data***
  - Type in the sample ID and enter the data from the logsheets.

- ***To verify data***

  - Before verifying the data entry, review the sample ID list by pressing F5. Make sure that every sample is entered and that none are entered incorrectly. Do this for radon, bios, bulk and QA/QC.
  - Type in Sample ID and verify information against logsheets.

◊ **Radon**

Radon canisters that were moved or tampered with during the exposure period are voided. Do not enter into IADCS.

Data entry conventions for sampling locations

Site Description field:

1. First enter the floor number (e.g., FL1, BAS, SUB BAS, MEZZ, CONCOURSE, GROUND) followed by a colon. Use the same language as appears on the radon maps, especially for parking garage levels (e.g., P3, or P7-P8). If multiple towers share a common footprint, enter a building identifier before the floor (e.g., TWR2: FL4, or BLDG C: BAS).
2. After the colon, enter a brief description of the location to facilitate finding the sample ID on the map. Do not use proper names or other language that might reveal the identity of the building. Avoid using statements like “near trash” or “next to plant”. Refer instead to doors, walls, type of room, elevators and stairwells.

Examples:

- FL5: ELEVATOR LOBBY
- Use fixed and mobile site identifiers as applicable, e.g., FL1: FIXED SITE 3
- Use compass directions if possible: e.g., FL2: SW STAIRWELL
- Some buildings are naturally in two or more parts (north and south, for example). Use these terms as part of the location, e.g., BAS: NORTH: NEAR FREIGHT ELEVATOR.

- ***Radon QC***

Compare the data to the field data sheets. Verify locations using the radon map.

◊ **Bioaerosols**

Note: Insert a note in the Device ID field if the FTM noted poor or irregular impaction on the Field Data Sheet.

Note: If outdoor bioaerosol sampling was not done at the outdoor fixed site (outdoor intake), then individual notes for each sampling location should be entered.

Example 1: "Sample taken approx. YY yards from the outdoor air intake. See Building Summary."

Example 2: "Sample taken on opposite side of building from outdoor air intake. See Building Summary."

◊ **Bulk**

Use the same location conventions as for radon except for fixed sites. For fixed sites, enter the phrase: CARPET AT FIXED SITE YY. If the description is too long, enter it in a note.

On rare occasions, dust may be collected from a surface other than a carpet. lf collection was done from a non-carpeted surface, enter the phrase: FLOOR AT FIXED SITE.

◊ **QA/QC**

Review each integrated Field Data Sheet for Field Blanks (FB), Shipping Blanks (SB) and QC Spikes. Expect the following blanks:

ALD 1 FB, 1 QC Spike

PPM 1 FB

CAN 1-2 FB, 1 QC Spike

TNX 1 FB, 1 QC Spike

RAD 2-3 FB

Bios 1 FB & 1 SB each type

- **Field Blanks (FB)**
  - Radon: For radon QA/QC data not taken at fixed or mobile sites, enter the location in a note.

- **Shipping Blanks (SB)**
  - No Time
  - No Site ID
  - OK to enter SBs for samples other than Biologicals

- **QC Spikes**
  - Begin entering data in MTR with Winter 97 Study

3.2.3 QA MTR Data Entry

The DSP is responsible for verifying that ***all*** information has been entered accurately by comparing it to the original log sheets. It is best to do this verification in the order in which the screens are organized in IADCS. This protocol should be followed for all data validation. Additionally, each reviewed data sheet should be initialed upon its completion.

Upon completion of data verification, the DSP should meet with the FTL to go over questions.

NOTE: Remember to delete records flagged for deletion using the IADCS Management component.

3.3 QUESTIONNAIRE DATA

An FTM will verify that summary information on the outside of the packet of questionnaires is accurate and complete. The following elements of the summary sheet will help provide BASE team members with a quick reference for that building's questionnaire information.

- Total # questionnaires distributed
- Questionnaires returned by Thursday night
- Questionnaires returned after Thursday (Friday)
- Total number of questionnaires returned
- Response rate
- IADCS ID #s used for the batch

3.3.1 Data Entry (ASP)

The ASP coordinates data entry of the questionnaires into IADCS.QSN. Prior to data entry the ASP affixes the QSN labels to page 1 of each questionnaire. Each questionnaire is initialed and dated once it is entered.

Blank questionnaires are not entered.

Data is entered into IADCS on the c: drive of the computer. The c:\iadcs\qsn folder should be backed up to the N: (BASE) drive n:\1backup\dateYY\ after each data entry session.

Notes

Test space=01
Survey code=last 4 digits of QSN label
Date received: Questionnaires received on Friday are marked "F". The others (no mark or marked "R") were returned on Thursday (the same day they were distributed).
To delete a record press Ctrl-Del from anywhere in the record. (This is a toggle command.)

Data entry conventions

Under the direction of EPA and supplementary in-house policy decisions, EH&E has adopted certain conventions for data entry. Because of the difficulty in interpreting some of the entries made by respondents, EH&E's conventions can not anticipate all of the judgement calls that will be made. The ASP should use the DSP or FTL as a resource for other questions of interpretation.

In general, enter the data as is, even if it is illogical. Questions left blank on the questionnaire are left blank in IADCS. Enter a respondent's comments as a note if they are not adequately expressed in the multiple choice answers.

Note: The last page of the questionnaire is not quoted. The last page in the IADCS QSN data entry software is a form that is used to summarize comments made by the respondent. Add notes to this form only if needed for clarification. Also include opinions here the respondent may have noted on earlier questions. This avoids entering notes. If comments are quoted, edit out information that would reveal the identity of the building.

3.3.1.1 General Data Entry Conventions for Ambiguous Responses

When respondent checks multiple boxes, enter the higher number (more education, dirtier workspace, more frequent use or occurrence). If respondent enters a fraction, round up to the nearest whole number. If respondent enters a range, e.g., 20-30 feet or 5-6 hours, enter the average (round up to the nearest whole number).

3.3.1.2 Data Entry Conventions For Specific Questions

Question ID	Problem	Action Taken
Section I. Workplace Info		
#1	Some respondents list # of years *and* # of months when only one is requested.	Round to the nearest year. Note: If a respondent has worked less than one year, enter 1 year if 6 months or more, otherwise enter the number of months.[1]
#2	Respondent uses a fraction, e.g., 37 1/2 hours.	Round up to the nearest hour: e.g., 37 1/2 --> 38 hours
#3	Some respondents reply that they have worked 5 days that week– probably without reading the question carefully.	Enter the response given.
#6	The respondent checks two answers.	Select the "dirtier" rating (higher number).
#11	The current "vertical" format of the questionnaire does not have the original first portion of the question, "do you work at a computer?"	If any hours are listed for daily use, enter a "yes" for this question. Otherwise, enter a no and proceed to #12.
#11a	Respondent enters 25 hours (thinking "per week").	Divide by 5; enter 5 hours per day.
#11b	Some respondents enter "contact lenses" as a note for this question.	Enter a "yes" for glasses.
#12 and 13	Respondent checks "no window" in #12 and leaves #13 blank. Respondent checks "no window" (answer #1) in #12 and enters a distance in #13.	Enter 9 for "no window" in #13. **2 options** Change #12 to read answer #2; leave #13. **OR** Leave #12 and change #13 to "no window."
Section II. Health & Well Being		
#3	This question poses some problems when respondents work in a smoke-free workplace. Sometimes they will mark a box, sometimes they will mark a box with a note, and sometimes they will just write a note, with no mark.	Enter only the mark. (If there is a note and no mark, enter nothing.)
#5	Some respondents mark more than one type of corrective lens.	Enter only ONE type of corrective lens, following this hierarchy: contact lenses, bifocals, glasses, none.
#5	Respondent specifies "trifocals."	Enter bifocals.
#8, 8a, and 8b	Some respondents do not follow the directions and enter contradictory answers.	Enter exactly what the respondent marked; this involves manipulation of the software to bypass the automatic advances from the first part of the question.
Section III. Workplace Conditions		
#1, 1a	Respondent indicates a specific odor.	Enter a note, e.g., food.
Section IV. Job Char.		
# 1	Respondent marks more than one answer.	Enter the higher of the two levels unless it is incommensurate with the person's education.
# 1	Respondent marks other but leaves it blank.	Enter a note: "Respondent did not specify."

Continued

Question ID	Problem	Action Taken
# 3	Some respondents either: 1) mark more than one answer, or 2) name a new category like "associates degree."	If two responses are listed, the data entry person should enter the highest level. If a new category is given, the data entry person should confer with another team member and assign the appropriate level. Interpret "associates degree" as "some college."
# 5	Two responses are selected.	Choose the more "stressful" option.

[1] This is especially important because IADCS will change an entry of 6 months to 1 year, 6 months, and the entry 11 months to 1 year, 11 months

3.3.2 Data Entry Verification (DSP)

The DSP will check at least 10% of the questionnaires from each building to ensure accuracy of the data entry. Acceptable accuracy is left to the best judgment of the PM or QA/QC officer. The DSP should be comfortable that questionnaire data entered accurately represents the original data. If more than 20-25% of the sample have more than 2-3 errors from each questionnaire, he/she may ask the data entry person to review the other questionnaires from the same day.

NOTE: Remember to delete records flagged for deletion using the IADCS Management component.

3.4 IMPORTING IADCS INTO SAS (MIS)

The data contained in IADCS is stored in *.dbf files. These types of files are read not only by IADCS, but by other database software as well. Mantech has written code which translates these *.dbf files into a format which SAS can read. Of course, SAS Access can also read the files directly, but importing the *.dbf using SAS Access would be an extremely time-consuming process. All of the fields would need to be renamed and formatted to match the existing SAS data. Using the existing importing programs from Mantech is much easier.

There are three separate sets of data imported into SAS: SVY, QSN and MTR. SVY and QSN contain the building survey data and questionnaire data, respectively. All of the data for both sets is completely contained within IADCS. MTR contains all of the environmental measurement data. Three types of data within MTR are not contained within IADCS: continuous monitoring data, the lab results for integrated data, and the

weather data. These three types of data are imported directly into SAS from the Excel files using SAS Access. IADCS MTR contains the following data:

- Biologic.dbf contains the field data for the biological integrated sampling (instrument, operator, site, flow information, sample ID, type of sample, date, time, etc.). Once imported into SAS, it is named Biologic.sd2.

- Fixed.dbf contains the field data for the non-biological integrated sampling (instrument, operator, site, flow information, sample ID, type of sample, date, time, etc.). Once imported into SAS, it is named Fixed.sd2.

- Mobile.dbf contains data about the mobile sites (Diffuser air flows; CO, CO_2, temp, and RH levels for the diffuser and mobile site; dust, odor, carpeting, noise and source surveys; and date, time and operator). Once imported into SAS, it is named Mobile.sd2.

- Personel.dbf contains a list of all the operators with their full names and ID's. Once imported into SAS, it is named Personel.sd2.

- Site.dbf contains detailed instrument data for each site. It lists both the integrated sampling pumps and the instruments used for continuous monitoring. Once imported into SAS, it is named Site.sd2.

- TSCounts.dbf contains counts of the test space occupants for each morning and afternoon of the week of sampling. It also contains a checklist for the questionnaires. Once imported into SAS, it is named TSCounts.sd2.

- Notemtr.dbf contains field notes for all of the above data sets. Once imported into SAS, it is named Notemtr.sd2. This data set must be reviewed very carefully, as items deleted from it in IADCS may reappear in SAS.

Any other *.dbf files found in the IADCS MTR directory may be ignored.

The following table lists the *.dbf files which need to be copied from the IADCS program directory for translation into SAS.

Table 3.2 IADCS Program Files to be Translated into SAS

MTR	QSN	SVY
Biologic.dbf	Survey.dbf	FileA1.dbf
Fixed.dbf	Comment.dbf	FileA2.dbf
Mobile.dbf	Noteqsn.dbf	FileA3.dbf
Personel.sbf		FileB1.dbf
Site.dbf		FileC1.dbf
TSCounts.dbf		FileC2.dbf
Notemtr.dbf		FileC4.dbf
		FileC5.dbf
		FileD1.dbf
		FileD4.dbf
		FileD5.dbf
		Notesvy.dbf

3.4.1 Translating the *.dbf files to text files

IADCS data is imported into SAS using a two-step process. First the *.dbf files are translated into text files using a Clipper executable files written by Mantech. Then, various SAS programs read these text files and import them into SAS data files (*.sd2). This section explains the first step.

The Clipper executable files are extremely sensitive to location. They will not work unless the directory structure exactly matches the format given below. There are three different Clipper executables, one for MTR, one for SVY, and one for QSN. Unfortunately, all three files are named the same, “dbftodat.exe.” They can be distinguished by date and time (see below).

Using Windows File Manager, copy the *.dbf files from the IADCS program directory into the appropriate directory listed below.

Directories are denoted by ALL CAPS, files are denoted by lower-case.

C:\IADCS
PROCESS

MTR
*.dat text files will appear here after running the program
SOURCE
copy the appropriate *.dbf files (see above list) from the IADCS program directory to this directory using Windows File Manager.

QSN
*.dat text files will appear here after running the program
SOURCE
copy all the QSN *.dbf files from the IADCS program directory to this directory using Windows File Manager.

SVY
*.dat text files will appear here after running the program
SOURCE
copy all the SVY *.dbf files from the IADCS program directory to this directory using Windows File Manager.

SAS
MTR
dbftodat.exe dated 12/9/95
QSN
dbftodat.exe dated 2/27/96, time 2:59:56pm
SVY
dbftodat.exe dated 2/27/96, time 3:04:02pm

Once the directory structure has been set up and the *.dbf files copied into it, the Clipper executable programs can be run, using SAS (for some reason they do not work just running on their own). For example, running the SVY dbftodat.exe in SAS causes all of the SVY *.dbf files to be translated to *.dat text files at the same time. The *.dat files will appear in the C:\IADCS\SVY\Process directory once the program has run. The other dbftodat.exe programs also completely translate their *.dbf files with only one execution. Their *.dat files will appear in the corresponding directories. Sometimes there is a problem with the Notes *.dbf files for the three sets of data. The Notes files can easily be imported into SAS using SAS Access.

The three SAS programs used to run the dbftodat.exe program are all called “dbftosd2.sas.” They are found in the appropriate SAS input program directory. If the *.dat text files do not appear after running the programs, check the directory structure. Also check to make sure the default directory for SAS is the C drive.

3.4.2 Translating the *.dat files to SAS data files (*.sd2)

IADCS data is imported into SAS using a two-step process. First the *.dbf files are translated into text files using a Clipper executable files written by Mantech. Then, various SAS programs read these text files and import them into SAS data files (*.sd2). This section explains the second step.

Mantech intended the SAS program dbftosd2.sas to perform both steps: calling the Clipper executable and translating the text files into SAS files. The dbftosd2.sas program can call other sub-programs which open up the text files and translate them into SAS. Rather than trying to get this one master program to work, it is simpler to use the master program to run the Clipper executable and to run each sub-program manually in SAS. There are 22 separate *.dat files to be translated into SAS. They have the same names as the original *.dbf files, just with a *.dat extension (see above table for the names of the files). Similarly, the SAS input programs have the same names with an *.sas extension, and the SAS data files the input programs produce have the same names with an *.sd2 extension. For example, the SAS input program FileC4.sas translates the text file FileC4.dat into the SAS data file FileC4.sd2.

3.4.3 Validating the IADSC SAS data files

The SAS input programs not only translate the text files into SAS, they also list the contents of the files in the SAS output screen. This output is sent to the printer, and given to the PM or IHTR for review. Make sure to clear the output screen before running the next input program; otherwise, the old data will print out twice.

NOTE: As mentioned earlier, carefully check any Notes data files. Entries deleted in IADCS will reappear. Fortunately, this does not generally happen with the rest of the IADCS data except when the building code is changed. The old building code record will be preserved in SAS. Check these SAS printouts carefully for these errors.

There are also validation programs in SAS for MTR data. Most of these do not involve MTR IADCS data. The ones that do also involve either the continuous monitoring data

or the integrated lab results data. More information can be found on the MTR validation programs in these sections.

4.0 INTEGRATED DATA PROCESSING

4.1 WEATHER DATA

A few weeks before the field study begins, a FTM should contact the EH&E Librarian or other EH&E staff member who knows how to obtain electronic weather data. A description of what is needed is presented (i.e., surface hourly data; typically Tuesday through Thursday, 0700 to 1900 for each study week). The librarian will determine the source and format of the data to be obtained and download the data into the appropriate file. It is important to obtain *station* pressure (uncorrected for altitude).

The Librarian and/or the DSP will do the formatting. Most likely, the temperature, dewpoint and pressure will need to be converted. Formulas can be copied from a prior worksheet; they are also referenced below.[1] Be sure to keep the same number of significant digits when making the conversions.

The table below shows the format of the data prior to export into SAS. Note: It is no longer necessary to use Line Printer font or to show the day.

Building	Date	Local Time	Temp (C)	Dewpoint (C)	Relative Humidity (%)	Station Pressure (mm Hg)
TNDS05 960715	7/16/96	6:53	20	19	93	766.3
TNDS05 960715	7/16/96	7:53	21	19	87	766.8

[1] To convert Farenheit to Celsius, multiply by the factor 5/9*(F-32). To convert inches of mercury to millimeters of mercury, multiply by the factor 25.4. To convert millibars to millimeters of mercury, multiply by the factor 0.750060.

4.2 LAB DATA FILING (DSP)

The integrated sampling results are received from the subcontractor laboratories in electronic format[2] and loaded into files on the BASE drive of the file server by the DSP (see table below for naming conventions). The hierarchy is: n:\1studies\ YRseason\data\integ\...\raw\ , e.g., 96s_al, 95w_ra

al	an	ba, bd, bl	fa, fd, fl	pm	qaqc	ra	vc
aldehydes	antigens	bacteria-air, dry, liquid	fungi-air, dry, liquid	particulates	QA/QC	radon	VOCs

The only place separate spreadsheets will exist for each sample will be in the raw directory.The MIS will collect all of the raw data for each type of sample into one spreadsheet, with one row per sample. This will make checking the data much simpler. The spreadsheet will have a second sheet containing a QC checklist to ensure that all the QC steps have been performed. The checklist will have a place for the data and the person's initials.

4.3 DATA PROCESSING

4.3.1 Overview

All integrated BASE data is reviewed for QA purposes, specifically for errors and consistency of coding. An FTM performs the preliminary raw data QA/QC, and then the first four QA/QC steps for the summary spreadsheet data (see below). An Industrial Hygiene-trained technical reviewer (IHTR) checks 10% of the data as a final QA measure. The data is then uploaded into SAS from *Microsoft Excel* using SAS Access. Various validation macros are run in SAS, and then the SAS datasets are sent electronically to the EPA.

4.3.2 Preliminary QA/QC

[2] With the exception of the antigen data from VESPA, which is entered into the Excel templates by the IHDC.

An FTM checks to make sure the lab has used the proper units, and that the "number of samples" number at the top of each sheet equals the number of samples. Be especially careful with ***biologicals***; follow the procedures below:

- Make sure that for each sample type, the species headings match on each of the raw data sets. Be especially careful with species listed at the far right. If one raw data template has extra species, insert columns on the other raw data templates to match up.

- Units for bulk-liquid sample results are colony forming units (CFU) per milliliter (CFU/mL).

- Units for bulk-dry sample results are CFU per gram (CFU/g).

- Units for air sample results are CFU per cubic meter (CFU/m^3).

- Results for all of these samples will include a column for total CFU per plate (CFU/plate), as well as other columns for sample duration, volume, mass, dilution volume, and dilution factors.

4.3.3 Data Consolidation

When the preliminary QA/QC has been completed on the raw data files, the "date" and "initials" cells must be updated. Then the raw data files are ready to be consolidated into summary spreadsheets.

For each type of sample and the corresponding lab template, *Excel* macros have been written to consolidate all of the data onto one spreadsheet. This process is necessary for the data to be imported into SAS. Once this process is complete, it becomes easier to QC the data files.

4.3.4 Data Validation

The following are the guidelines for processing the integrated data once they are in the summary spreadsheet format. For each type of sample, there are five separate steps: general QA/QC, coding, post-coding calculations, flagging, and QA/QC of 10% of the data by the IHTR. Instructions for each step are listed below. Specific guidelines for each sample type are in a checklist format to ensure that all steps are performed. The person performing each task enters her initials in the space provided.

4.3.4.1 General QA/QC (FTM)

This is a general visual inspection of the data, ensuring consistency of data (building codes, typical values, etc.). Also, at this time the sample results are matched with the field logsheets and Chain of Custody forms. QA/QC samples (lab blanks, etc.; a list is given below) are removed from the data and filed in a separate directory. Occasionally, depending on the blank values, blank correcting must be done on certain sample types. This process is explained in the next section (sec. 4.4).

4.3.4.2 Coding Integrated Data

The laboratories do the coding (except for VOCs), but it is checked by the IHTR. The coding assumptions are listed below.

- Code Definitions:
  -95 - Sample voided by laboratory.
  -96 - Sample not analyzed, or value not calculable.
  -97 - Less than the minimum detection limit.
  -98 - Less than the minimum quantitation limit.
  -99 - Greater than the highest calibration standard.

- For all blank samples, results cannot be presented in terms of mass per volume; only mass per sample is meaningful. Thus, all blanks results are coded as -96 unless the results were in mass per sample.

NOTE: The one exception to this rule is radon. The radon template allows only for the reporting of pCi/L. For radon blanks, the results are reported assuming a sample volume equivalent to those of the normal samples.

4.3.4.3 Post-Coding Calculations (IHTR)

The various calculations done by the laboratories must be verified, especially if any concentration values have been recoded in the previous step. The verification formulas for each sample have already been set up in *Excel* spreadsheets, and just need to be copied and pasted into the summary spreadsheets. After any blank corrections, calculations and coding should be checked again.

4.3.4.4 Flagging Integrated Data

Since all the data for each type of sample is collected from the raw data files into a summary spreadsheet, flagging high or unusual values is simple. Open the summary spreadsheet for each sample type and sort the data by concentration. If any of the data meets the criteria listed below, copy those rows, paste them into a separate data file, and print the file for QC use. These values are reported to the building manager and used in the building reports. (The same process can be used for finding the min, max, and other values needed for the building summaries.)

4.3.4.5 Final QC

The QA/QC Officer checks 10% of data for each integrated parameter.

4.3.5 Data Processing Checklists

Following are the data processing checklists for each of the integrated parameters.

ALDEHYDE	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Sample volume should equal 0.10 cubic meters, ±20%.
	If blank concentrations are greater than .05 µg/sample, all sample data must be blank corrected. (See instructions at end of this section).
	Coding
	All blank results should be coded as -96 unless the results were in mass per sample.
	µg/m3 and ppb field and method blanks should be coded as -96.
	Blank concentrations less than .05 µg/sample should be coded as -97.
	Berkeley uses both an LOQ and an LOD.
	Post Coding Calculations
	Concentrations in $\mu g/m^3$ should equal mass ÷ volume.
	Check that ppb = $\mu g/m^3$ * 24.45 ÷ molecular weight.
	Flagging
	Concentrations which are greater than 16 ppb should be flagged.
	Any codes other than -96, -97 and -98 should be highlighted.
	QC by IH
	IH has QC'd 10% of data.

ANTIGEN	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Coding
	All blank results should be coded as -96 unless the results were in mass per sample.
	A result less than the limit of detection (LOD) should be coded as -97.
	Post Coding Calculations
	Flagging
	Concentrations of antigen > 8 ug/g of dust should be flagged.
	QC by IH
	IH has QC'd 10% of data.

Bacteria Air	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Volume should be 0, 0.0556 or 0.1412 m^3.
	Time should be 0, 2 or 5 minutes.
	Coding
	All blank results should be coded as -96 unless the results are in mass per sample.
	Any volumetric measure of a blank should be coded as -96.
	All -98s should be changed to -97s.
	Cell concentration columns (cocci, rods, actinos, bacillus, unknown, Total CFU/plate) should never read zero; change them to -97.
	For thermophilics, the only taxa categories analyzed are actinos, bacillus, and unknown. According to HSPH, the other classes are not applicable. No other taxa are analyzed and should be coded as -96. For thermophilics only: the -97s to -96s in the cell cocci and rods columns should be changed. If there is Gram+ or Gram-, or Cocci growth it should be noted in the comments section.
	Post-Coding Calculations
	Volume = Time * 0.0283.
	Total CFU/m^3 = Total CFU/plate ÷ Volume. Total CFU/m^3 = Σ species CFU/m^3. These calculations should be checked as several errors have been found this way in the past.
	Flagging
	Any total CFU/m^3 which are greater than 500 should be highlighted.
	All -99s should be highlighted; there should be very few, if any.
	QC by IH
	IH has QC'd 10% of data.

Bacteria Dry	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	The incubation temperatures for bulk samples are 55^{o}C and 30^{o}C (there should be two incubations for each sample).
	The incubation temperature for dust samples is 30^{o}C.
	Coding
	For samples with 55^{o}C temperatures, the cocci and rod columns should read -96. For thermophilics, the only taxa categories analyzed are actinos, bacillus, and unknown. According to HSPH, the other classes are not applicable. All other taxa are not analyzed and should be coded as -96.
	CFU per plate or per gram should be a number or a -97, but never a zero.
	Post Coding Calculations
	The total CFU/g should equal the sum of the speciated columns. Total CFU/g = 10 * DV*DF*Total CFU/mass. DV=dilution volume, DF=dilution factor.
	Flagging
	All -98 or -99 codes should be highlighted.
	For dry bulk samples only, highlight if the Total CFU/g number is greater than 1,000,000.
	Highlight the “Comment” column if there is no information detailed there.
	QC by IH
	IH has QC’d 10% of data.

Bacteria Wet	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	The incubation temperatures for bulk samples are 55^{o}C and 30^{o}C (there should be two incubations for each sample).
	Coding
	For samples with 55^{o}C temperatures, the cocci and rod columns should read -96. For thermophilics, the only taxa categories analyzed are actinos, bacillus, and unknown. According to HSPH, the other classes are not applicable. No other taxa are analyzed and should be coded as -96.
	CFU per plate or per ml should be a number or a -97, but never a zero.
	Post Coding Calculations
	The total CFU/ml should equal the sum of the speciated columns. Also: total CFU/mL = 10 * DF * total CFU/plate. (DF=dilution factor)
	Flagging
	All -98 or -99 codes should be highlighted.
	The “Comment” column should be highlighted if there is no information detailed there.
	QC by IH
	IH has QC’d 10% of data.

FUNGI AIR	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet is reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	The listed volume should be either 0, 0.0556 or 0.1412.
	All columns except Total CFU/plate should have decimal numbers, not integers (excluding codes).
	Time should be 0, 2, or 5.
	Coding
	All blank results should be coded as -96 unless the results were in mass per sample.
	Total CFU/plate should be a whole integer or a -97, never zero.
	For blanks, all but the Total CFU/plate column should read -96.
	All zeroes in any concentration column should be changed to -97s.
	Post Coding Calculations
	Total CFU/m3 = Total CFU/plate ÷ volume. This also equals the sum of all speciated concentrations.
	Flagging
	A total CFU/m^3 > 500 should be highlighted.
	QC by IH
	IH has QC'd 10% of data.

FUNGI DRY	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Coding
	All blank results should be coded as -96 unless the results were in mass per sample.
	CFU per plate should be a number or a -97, but never a zero.
	Post Coding Calculations
	The total CFU/g should equal the sum of the speciated columns.
	Also, Total CFU/g = CFU/plate * 10 * DV * DF / mass.
	Flagging
	All -98 or -99 codes should be highlighted.
	For dry bulk samples only, a total CFU/g number is greater than 1,000,000 should be highlighted.
	The “Comment” column should be highlighted if there is no information there.
	QC by IH
	IH has QC’d 10% of data.

FUNGI WET	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet is reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Coding
	All blank results should be coded as -96 unless the results were in mass per sample.
	CFU per plate should be a number or a -97, but never a zero.
	Post Coding Calculations
	The total CFU/ml should equal the sum of the speciated columns.
	Also, Total CFU/mL = 10 * DF * Total CFU/plate.
	Flagging
	All -98 or -99 codes should be highlighted.
	The “Comment” column should be highlighted if there is no information there.
	QC by IH
	IH has QC’d 10% of data.

PARTICULATE	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Volume must equal 10 cubic meters, ±20%.
	If blank concentrations are greater than 10 μg/sample, all sample data must be blank corrected. (See instructions below).
	Coding
	All blank results (in $\mu g/m^3$) should be coded as -96 unless the results were in mass per sample.
	Blank concentrations (in mg/sample and mg/m^3) less than 10 μg/sample should be coded as -97.
	Post Coding Calculations
	Flagging
	Concentrations greater than 150 $\mu g/m^3$ should be flagged.
	QC by IH
	IH has QC'd 10% of data.

RADON	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet is reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Coding
	Any values less than 1.0 pCi/L should be coded -97.
	Post Coding Calculations
	Flagging
	Any values greater than 4.0 Ci/L should be highlighted.
	Any codes other than -97 (including Field Blanks) should be highlighted.
	Any duplicate value greater than the corresponding sample by 0.5 pCi/L, or any which is a -97 when the corresponding sample is a number should be highlighted. (This will involve sorting by sample ID rather than by concentration.)
	QC by IH
	IH has QC'd 10% of data.

VOC	
Initials	**Task**
	General QA/QC
	Building codes should be checked.
	Site specific information from the field logsheets should be added.
	Each sample on the summary spreadsheet should be reconciled with the appropriate Chain of Custody (COC) forms and field logsheets.
	All lab blanks, lab spikes and PE lab duplicate analyses samples must be transferred to a separate file. This means that any rows in the summary spreadsheet corresponding to these samples must be cut and pasted into a separate QA/QC spreadsheet.
	Coding
	All blank results should be coded as -96 unless the results were in mass per sample.
	For VOC blanks, the results include a list of detection limits in mass per volume and volume per volume. These limits of detection (LODs) should be left with the results although they are not applicable to the blanks because blanks can only be related to mass per sample quantities. For **Method** and **Field Blank** samples, the µg/m3 and ppb columns should be coded as -96.
	Performance Analytical uses both an LOQ and an LOD. The detection limits used by the laboratories for VOC's are different from the ones used by EH&E, so the IHDC is responsible for entering all the codes for VOC's (a macro has been written to do this automatically).
	Post Coding Calculations
	Flagging
	All codes other than -97 or -98 should be highlighted.
	Any benzene concentration greater than 20 ppb should be highlighted.
	Any other concentrations which are greater than 200 ppb should be highlighted.
	QC by IH
	IH has QC'd 10% of data.

4.4 CORRECTING FOR FIELD BLANKS (IHTR)

When field blanks in integrated data files have significant values (i.e., values other than -96, -97, -98, etc.), these values are used to "correct" sample data associated with the blank. The process is referred to as blank correcting.

NOTE: Blank corrections are performed only on particulate and aldehyde sample data.

- Begin by looking at the mass or weight of the field blank:

Sample ID	Mass (μg)	Volume (m3)	Concentration (μg/m3)	Comments
EHPPM0427	10	0	-96	Field Blank

The mass of the above sample is greater than the detection limit for the particular parameter. Therefore, the blank mass must be used to correct all other samples associated with the blank.

- To correct the concentrations, subtract the field blank's mass or weight from the masses or weights of the other samples. Then calculate the concentrations of the other samples (concentration = mass / volume).

- For example, the data sets shown below are the uncorrected values.

Sample ID	Uncorrected Mass (μg)	Volume (m3)	STP Uncorrected Concentration (μg/m3)	Comments
EHPPM0421	111	11.266	9.852	F3
EHPPM0423	405	10.712	37.809	F0 Duplicate
EHPPM0424	144	11.008	13.082	F3 Duplicate
EHPPM0427	10	0	-96	Field Blank
EHPPM0430	405	10.712	37.809	F0

Since the mass of the blank sample is 10 μg (equal to or greater than the LOD of 10 μg), all sample data must be adjusted by decreasing the mass of the associated samples by the mass of the blank sample.

- The adjusted concentrations will be as shown:

Sample ID	Corrected Mass (µg)	Volume (m3)	STP Corrected Concentration (µg/m3)	Comments
EHPPM0421	101	11.266	8.99	F3
EHPPM0423	395	10.712	36.87	F0 Duplicate
EHPPM0424	134	11.008	11.81	F3 Duplicate
EHPPM0427	10	0	-96	Field Blank
EHPPM0430	395	10.712	36.87	F0

- Be sure to note the correction in the data logbook and enter your initials and the date at the top of the file.

4.5 CALCULATING INTEGRATED DATA VOLUMES

4.5.1 In the Field (FTM)

The IMPACTOR, PUMP, and ROTAMETER module for measuring particulates and aldehydes is set up on Wednesday of the field sampling week. A field data sheet is filled out noting the following information (measurements are taken in the field):

- Sample ID (generated in-house)
- IMPACTOR ID NUMBER (noted on instrument)
- LOCATION (i.e., roof, S.1, etc.)
- QA type:
  S = sample
  D = duplicate
  F = field blank (sometimes entered as FB)
- PUMP ID (noted on instrument)
- ROTAMETER ID (noted on instrument)
- FLOW ON
- FLOW OFF[3]

[3] The Rotameter is connected at the beginning of measurement. The FLOW ON meter is read and the Rotameter is disconnected until the end of measurement, when it is reconnected and the FLOW OFF reading taken.

- PUMP ON (pump “odometer” reading at the start of measurement)
- PUMP OFF (pump “odometer” reading at the end of measurement)
- ON TIME (actual time at the start of measurement)
- OFF TIME (actual time at the end of measurement)
- PM_{10} sample (see Int 6: PM Sampling for # of samples taken)
- $PM_{2.5}$ sample (see Int 6: PM Sampling for # of samples taken)

4.5.2 Volume Calculations

For aldehyde, PM and Multisorbent samples, the volume of air sampled must be calculated. To facilitate these calculations, information from the field data sheets, together with the temperature and pressure, is entered into an Excel template. This template is located in n:\1studies\YYseason\data\rotas\.

NOTE: For indoor sites, 70°F is used for temperature. Outdoor temperatures are obtained from the Novalogger data. Barometric pressure is obtained as described in Section 4.1 Weather, above. Pressure readings will be obtained by the field teams as equipment becomes available.

The template worksheet automatically calculates the Total Volume (cubic meters) corrected to STP for each sample. Refer Section 4.6, *Calibrating Rotameters,* for a description of STP volume calculations.

4.6 ROTAMETERS

4.6.1 Background

Rotameters measure the quantity of volumetric airflow through the sampling media. The height of the rotameter float corresponds to the airflow rates through the rotameter. This height is determined by the forces acting upon it: the force of gravity and the drag forces on the float from airflow. An equation for airflow through a rotameter can be derived from the balance of these forces:

$$\mathbf{Q} = C_r \cdot \mathbf{A}_0 \cdot \sqrt{\frac{2gm_f}{\rho_g \cdot A_f}} \qquad \text{Equation (1)}$$

where:
Q = volumetric flow
C_r = unitless rotameter constant, typically 0.6 - 0.8
A_0 = area of opening at float position
g = acceleration due to gravity
m_f = mass of float
ρ_g = density of air
A_f = cross-sectional area of the float

For any given rotameter, almost all of the above variables are constants and the volumetric flow varies with only two factors: the area of the tube opening at the float position (which varies only with the height of the rotameter float), and the density of air (which varies with pressure and temperature). Thus, from Equation (1), the volumetric flow indicated by a given float position will vary only with the square root of the density of air. An equation for the density of air follows:

$$\rho = \frac{\mathbf{MW} \cdot \mathbf{P}}{\mathbf{R} \cdot \mathbf{T}} \qquad \text{Equation (2)}$$

where:
MW = molecular weight of gas of concern
P = pressure of gas of concern
R = ideal gas constant
T = temperature of gas of concern

4.6.2 Calibration of Rotameters

Rotameters are calibrated at EH&E using a primary standard for volumetric flow, (i.e., a soap bubble meter). For each rotameter used in BASE, volumetric flows were measured at approximately five rotameter points in the region of interest (e.g., 200 cc/min for formaldehyde sampling, and 20 L/min for particulate sampling).

It was assumed that over the region of interest, the relationship between volumetric flow and rotameter float height could be modeled by a linear regression equation. This assumption was confirmed by the high values of R^2 obtained for each regression. For each rotameter, a linear regression equation was derived from the rotameter heights and the corresponding volumetric flows:

$$\mathbf{Q}_L = \mathbf{a}_L \cdot \mathbf{R} + \mathbf{b}_L \qquad \text{Equation (3)}$$

where:

$_L$ = conditions in the laboratory at the time of rotameter calibration

This equation applies only to rotameter readings taken at the same environmental conditions as where the rotameter was calibrated. To attain consistency among the different environmental conditions for which its rotameters were calibrated, EH&E corrects Equation (3) for all its rotameters to NTP [=EPA STP] (25^{o}C and 760 mm Hg). From Equation (1), the volumetric airflow is inversely proportional to the square root of the air density. hus, for a given rotameter float height, the ratio of the volumetric flows at two different environmental conditions is equal to the square root of the ratio of the air densities. Thus, the linear regression equation for volumetric flow at laboratory conditions can be converted to an equation at NTP by the equation below:

$$\mathbf{Q}_{NTP} = \mathbf{a}_{NTP} \cdot \mathbf{R} + \mathbf{b}_{NTP} \qquad \text{Equation (4)}$$

where:

$$a_{NTP} = a_L \cdot \sqrt{\frac{\rho_L}{\rho_{NTP}}}$$

$$b_{NTP} = b_L \cdot \sqrt{\frac{\rho_L}{\rho_{NTP}}}$$

As noted in Equation (2), densities of air vary only in pressure and temperature. Therefore, the ratio of two densities will be the ratio of their pressures and temperatures. The following equation demonstrates this ratio:

$$\frac{\rho_L}{\rho_{NTP}} = \frac{\frac{\mathbf{P}_L}{\mathbf{T}_L}}{\frac{\mathbf{P}_{NTP}}{\mathbf{T}_{NTP}}} = \frac{\mathbf{P}_L \cdot \mathbf{T}_{NTP}}{\mathbf{P}_{NTP} \cdot \mathbf{T}_L} \qquad \text{Equation (5)}$$

4.6.3 Determination of Field Flow Rates from Calibrated Rotameters

In the field, pressure and temperature are different than at NTP. To compute the true volume collected at field conditions, a new rotameter line must be derived for the relationship between float height and volumetric flow at field environmental conditions:

$$Q_{field} = (a_{NTP} * R_{field} + b_{NTP}) * (\rho_{NTP} \div \rho_{field})^{0.5} \quad \text{Equation (6)}$$

The above equation will give the actual flow rate at field conditions.

4.6.4 Calculation of Sample Volumes

The sample volume can be calculated via the equation below:

$$V_{field} = Q_{field} \cdot t_{sample} \quad \text{Equation (7)}$$

where:

t_{sample} = sample duration

V_{field} = total sample volume at field conditions

4.6.5 Sample Volumes Corrected to NTP and STP

The ideal gas law can be used to convert volumes from one set of environmental conditions to another. Thus, NTP and STP sample volumes can be calculated thus:

$$\mathbf{V}_{\text{NTP}} = \mathbf{V}_{\text{field}} \cdot \frac{\rho_{field}}{\rho_{\text{NTP}}} \qquad \text{Equation (8)}$$

$$\mathbf{V}_{\text{STP}} = \mathbf{V}_{\text{field}} \cdot \frac{\rho_{field}}{\rho_{\text{STP}}} \qquad \text{Equation (9)}$$

4.6.6 Concentration Calculations at NTP and STP

Laboratory results for formaldehyde and particulates were reported to EH&E in units of mass per sample. Sample results were calculated for reporting to EPA by dividing sample mass by sample volumes corrected to STP and NTP, as above. Equations (10) and (11) give the calculations used for mass per volume concentrations corrected to STP and NTP:

$$\mathbf{C}_{masspervolume,NTP} = \frac{\mathbf{sample} \cdot \mathbf{mass}}{\mathbf{V}_{\text{NTP from equation (9)}}} \qquad \text{Equation (10)}$$

$$\mathbf{C}_{masspervolume,STP} = \frac{\mathbf{sample} \cdot \mathbf{mass}}{\mathbf{V}_{\text{STP from equation (9)}}} \qquad \text{Equation (11)}$$

For formaldehyde, volume per volume concentrations in ppm are also calculated by multiplying the mass per volume concentration at NTP in mg/m^3 by the volume in liters of one mole of air at NTP and dividing by the molecular weight of formaldehyde. Because volume per volume concentrations are the same at STP and NTP and any other temperature and pressure, only one volume per volume concentration is reported per sample. Equation (12) presents the calculation for volume per volume concentrations in ppm:

$$\mathbf{C}_{\text{v/v, ppm, NTP}} = \mathbf{C}_{\text{v/v, ppm, STP}} = \frac{\mathbf{C}_{\text{mg/m3, NTP}} \cdot 24.45}{30.0} \qquad \text{Equation (12)}$$

4.7 INTEGRATED QC SAMPLES

A variety of QC samples are required for BASE. Below is a description of the various QC sample types and how they are segmented from the normal building files:

- **Field Blank:** A sample prepared by the Field Team which represents the procedure for preparing integrated sampling, but is not a regular sample. Field blanks are sent blind to the laboratory.

- **QC Spike:** A sample which is spiked by the analytical laboratory, sent to the field team, then sent back blind to the analytical laboratory within a regular sample shipment.

The following samples are itemized in special QC sample templates which are separate from IADCS and the regular building integrated templates:

- **Lab Sample (Blanks or Spikes):** A sample which is prepared by the analytical laboratory prior to receipt of a sample shipment from the field. This sample is not sent into the field, but is analyzed along with the field samples.

- **Performance Sample (Evaluations or Demonstrations):** A Demonstration sample is a sample prepared by a party other than the analytical laboratory and sent directly to the analytical laboratory without blinding. An Evaluation sample is a sample prepared in the same manner and sent to the field team to be incorporated blind into a regular sample shipment.

5.0 BUILDING SUMMARIES (FTL)

The Building Summary is one of the most important elements of the final data package because it allows for a simple review of a building's background information, its configuration, and uses. The information contained in the building summary is a compilation of the IADCS data, the continuous monitoring data, and the integrated sampling data. The building summary also details information not readily available as part of the general data package, such as events occurring during the study week, and suspected sources noted by the field team, as well as specific problems encountered during the study week.

A building summary template has been developed to ensure that the information documented in the summary remains consistent throughout. Using the building summary template, the Field Team Leader (or member of the Field Team) must prepare each summary and ensure that all information is entered as accurately and completely as possible. The Building Summary should be prepared within two weeks of the field week.

5.1 BUILDING SUMMARY OVERVIEW

The following sections detail the information contained in a typical BASE building summary.

5.1.1 Introduction

- Information is entered regarding the building location, the date of the field study, and the general ambient conditions noted throughout the field week. Locations are entered in reference to the BASE building code as well as the EPA region.

5.1.2 Resources and Schedule

- Information is entered regarding the field team conducting the study and the field study schedule.

5.2 BUILDING CHARACTERIZATION

- Building construction dates and building type (materials of building skin, window types, etc.).

- Number of floors and uses (# of floors above/below grade, usage on different floors, and gross and occupied square footage).

- Building smoking policies.

- Parking and service vehicle access and location in relation to the building.

- Number of occupants in entire building.

5.3 STUDY ZONE CHARACTERIZATION

- Study area location within the building.

- Sampling zone description (enough detail to allow visualization, usages/areas within the study zone, number of occupants, gross and occupied floor areas, smoking policies, information regarding renovations).

5.4 STUDY AREA HVAC DESCRIPTION AND PERFORMANCE

- Ventilation system (describe HVAC layout in detail, how it works, OA/IA mixing, cooling system, # fans, SA & RA, SA & cooling capacity of all AHUs, location/working of mechanical room, control system(s), deviations from initial design, design flaws, specifics of study area HVAC system, #/type of diffusers in study area, maintenance of HVAC system (overall and in study area).

- Summary of HVAC measurement results.

5.5 CONTINUOUS/MOBILE MONITORING AND INTEGRATED SAMPLING SUMMARY RESULTS

- Summarize results of mobile monitoring performed within the study area. This summary includes maximum and minimum results for air flow measurements, carbon dioxide, temperature, and relative humidity.

- Summarize results of continuous monitoring performed within the study area and at the outdoor site. This summary includes maximum and minimum results for air carbon dioxide, carbon monoxide, temperature, relative humidity, light, and sound. Refer to the Continuous Monitoring Review Worksheet.

- Summarize results of integrated sampling performed within the study area and at the outdoor site. This summary includes maximum and minimum results for particulates, radon, aldehydes, selected VOCs, and bacteria.

- List response rate statistics for questionnaires.

5.6 OTHER INFORMATION

- Special uses and activities occurring within or outside of the building (e.g., printing, graphics, smoking lounge, other potential IAQ issues).

- Potential pollutant sources (ambient sources, sources within the building, occurrence of pollution contamination during study week).

- Difficulties in applying the BASE protocol (problems with study design, measurement problems with HVAC system).

- Field problems (list instrument malfunctions or data loss).

The building summary is included with the data package for submission to EPA in both electronic and hard copy formats (Section I: Building Summary).

6.0 PHOTOGRAPHS (ASP & FTL)

Photo logsheets are used to record and describe any pictures taken in the field. A Field Team Member brings these logsheets, along with the exposed rolls of film, back to EH&E. The ASP sends the film out to be processed. The film is returned to EH&E in three different formats: slides (and duplicates), prints (and duplicates) with negatives, and computer diskette.

The ASP gives one set of prints to the HVAC FTM for review. The FTM selects photos to submit to EPA, numbers them, and prepares captions for them.

It is important to select photos that do not reveal the identity of the building or its location. Examples of shots which should be removed for confidentiality purposes include:

- Shots depicting the name of the study building (i.e., on the building facade).
- Shots depicting the name of a building occupant (i.e., office nameplates).
- Shots depicting street signs.
- Shots depicting automobile license plates.
- Shots depicting office names (e.g., “Jury Commissioner”).

The ASP types up the captions and gives them to the FTL for a final verification. Then the labels are affixed to the slides and prints, and colored dots are placed on the slides. Slides are color-coded in the following manner:

Green = HVAC-related shots

Blue = outdoor shots

Yellow = indoor shots (of both the Study and Staging areas)

Red = miscellaneous shots

The prints and slides are then placed in protective coverings and put into the data package binder (Section II: Slides/Prints). Discard slides and prints not used for submittal. Negatives are filed in the 3-ring “photo” binder.

The ASP also captions the photos on disk using Seattle FilmWorks' *PhotoWorks* software. An "album" file of the selected shots is produced and reviewed by the FTL. The ASP notifies the MIS when the albums are ready for electronic submittal.

7.0 BUILDING PLANS

A Field Team Member brings back to EH&E the assorted building plans for a study week and gives them to the FTM in charge of processing them (usually the Mechanical Person). There are four categories of plans to prepare: HVAC plans, Radon Maps, Diffuser Maps, and the Study Area Map.

7.1 PLAN DUPLICATION

The FTM selects the plans needed for submittal and prepares them for duplication. For all plans this means:

- Check all plans for clarity, neatness and completeness.
- Remove building identifiers.

In addition, the following is completed for each type:

HVAC Plans

- Highlight areas of interest and make notes.
- Give these to the ASP for duplication.
- Reproduce highlighting on duplicate. It is important to ensure that the original plan IDs are preserved, (e.g., "M-17 Plan), because specific plan titles are referenced in the IADCS SVY mode.

Radon Maps

- Check that all radon locations and sample IDs are clearly marked.
- Photocopy.

Diffuser Maps

- Verify locations and numbers of all measured diffusers.
- Check locations of fixed and mobile monitoring sites.
- Photocopy.

Study Area Map

- Check that the tiles are clearly labeled including squares removed from consideration as sampling sites.
- Photocopy.

7.2 FINAL PREPARATION

- The FTM reviews the duplicates for clarity and legibility.

- The FTM prepares a list of plan labels for the ASP who prints and adheres them to the plans.

- The ASP or FTM folds the plans and inserts them into binder leafs in the data package binder (Section III: Building Plans).

- It is imperative that a careful QC is performed for confidentiality.

8.0 DATA TRANSMISSION TO EPA

Electronic data is uploaded to a 100MB zip drive and sent via overnight delivery. Data not conducive to electronic submittal (building plans, maps, etc.) is sent via overnight delivery.

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY OF TERMS

blind a sample sent to an analytical laboratory concealed within a regular sample shipment for QC or QA purposes.

EPA STP EPA defined Standard Temperature and Pressure (25°C , 760 mmHg)

APPENDIX B

FLOOR AREA CALCULATIONS

FLOOR AREA CALCULATIONS

Building-Wide Area Calculations

There are guidelines in the IADCS manual and in the <F1> help menu in the software for the calculation of gross and occupied floor area, as per the following instruction:

> "Gross floor area is the total floor area for the entire building. Occupied floor area includes only that space which is currently occupied. Do not correct for the building core, interior walls, or columns."

Some general interpretations for the two calculations were used during the 1994 study. Specifically, IADCS notes linked to the two calculations from the 1994 data submittal indicated the following assumptions:

- **Building Wide Gross Floor Area:** This value is comprised of the total area within the building footprint, including all parking areas integral to building structure. In two cases in the 1994 data, parking areas not integral to building structure were omitted.

- **Building Wide Occupied Floor Area:** In most cases for the 1994 building set, calculations were based upon inclusion of areas that are currently tenanted.

  Excluded: Mechanical rooms, utility closets, stairwells, elevator shafts, janitorial closets, common hallways, atriums, restrooms, currently vacant office space, etc.

  Included: Tenanted office space, conference rooms, auditoriums, retail areas, and file and record storage areas.

Although most of the occupied floor area calculations for the 1994 data were consistent with these assumptions, it appears that, in a few cases, slight variations were adopted by the individual field teams and noted in IADCS with the given value.

To ensure consistency in future data submittals, a new format has been devised for Test Space Area that includes gross and occupied areas.

Test Space Area Calculations

- **Test Space Gross Area:** The process of defining a test space will yield the test space gross area. Field teams should use the following guidelines in defining the test space:

  Excluded: Mechanical rooms, utility closets, stairwells, elevator shafts, any currently unoccupied vacant office space, and any other areas deemed inappropriate for inclusion in the study area.
  Included: Currently occupied tenant office space, bathrooms, janitor's closet, common hallways, etc.

  The resulting test space gross floor area will reflect all elements of the tested area for the week (i.e., where diffuser measurements are taken and where light bulbs are counted.)

- **Test Space Occupied Area:** This area will be calculated by taking the gross test space area and subtracting all areas that are not considered tenanted space.

  Excluded: Common hallways, bathrooms, janitor's closet, cafeterias, etc.
  Included: Interior areas of tenanted office (i.e., conference rooms, filing rooms, kitchenettes, etc.).

Please note that a test space's occupied floor area may include tenant areas that would not be eligible in the fixed and mobile site "tiling" procedure.

- **Test Space Design Floor Area Per Workstation:** In most cases, this space should be calculated by taking the test space occupied area and dividing by the total number of workstations (permanently occupied workstation by someone who works more than 20 hours per week, NOT shared workspaces like computing clusters, etc.) counted during the sampling week. In some cases, however, the field team will need to make a judgment call regarding the inclusion of significantly large tenant areas that do not contain workstations. In such cases, the following guidelines should be observed.

  Excluded: Tenant customer service areas, file storage areas, cafeterias, libraries, etc.
  Included: Small tenant copying rooms, conference rooms, small break areas, etc.

  In any case, an <F6> note should be included to document the decision made by the field team.

NOTE: In the case of both building wide and study area calculations, be sure to provide notes in IADCS to qualify assumptions.